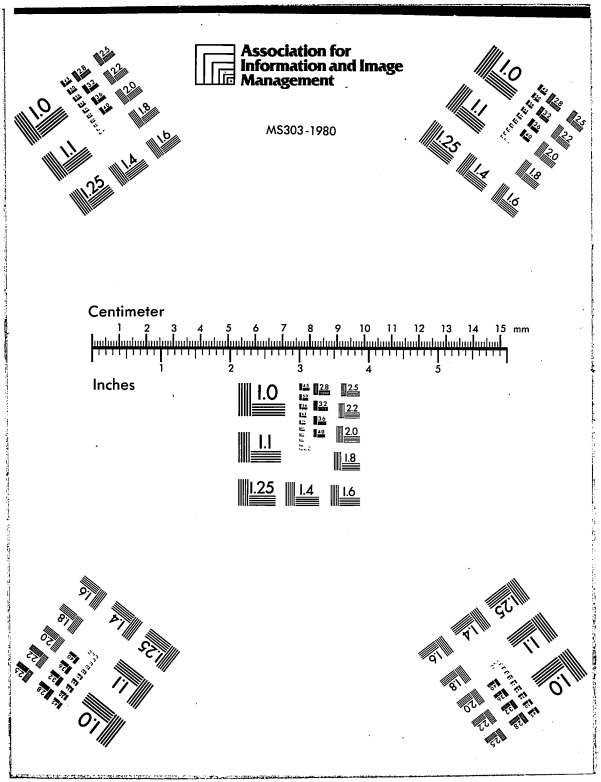
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1987

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18 June 1981

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A SELECTIVE MICROFILM EDITION
PART II
(1879-1886)

REEL 31

NOTEBOOK SERIES (NBK-9)

Menlo Park Notebooks, #22 - #32

Menlo Park Notebook #22 [N-79-03-10.1]

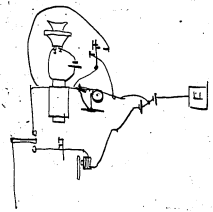
This notebook covers the period March 1879-February 1880. Many of the entries are by Edison. There are also entries by Charles Batchelor and Francis Upton. The names of John Kruesi and John Ott appear occasionally as witnesses. The material relates to experiments on electric lighting and on the telephone. Among the electric light material are notes and drawings of metal and carbon filament lamps, including vacuum experiments; notes, drawings, and calculations about generators; calculations for electric power distribution systems; and drawings of test apparatus. The telephone material consists of notes and drawings by Edison and Batchelor. The book contains 281 numbered pages.

Blank pages not filmed: 104-113, 120-123, 126-129, 132-133, 138-143, 146-147, 194-205, 210-211, 226-235, 266-267.

Missing page numbers: 115-116, 133-134.

No 22

March 10 1879
Tag



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BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

.....AL ELECTRIC

....., 189..

March 9 1879 Sat 3

Try stiffer springs from Dr design to Chuck.

Dry Chuck out.

Try Mobograph receivers in an Secondary coil.

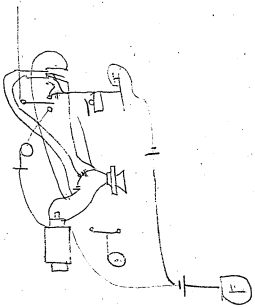
Shunt Receivers with plain resistance

Shunt with a magnet,

Test with Candle Scale Coils

March 10 1879
Taf

March 10 1879
Taf



March 10 1879

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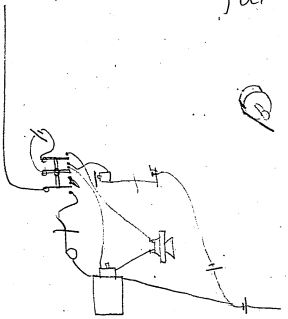

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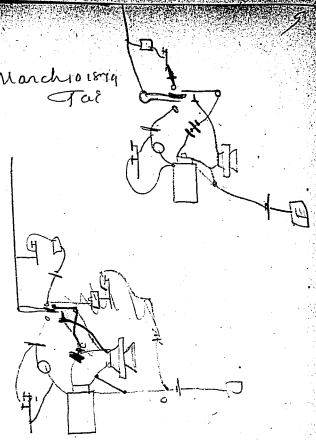
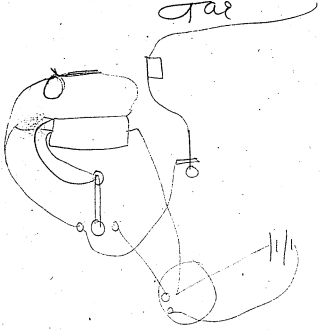
Marchio estq
Tal



March 10 1879

Gas



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March 10 1879
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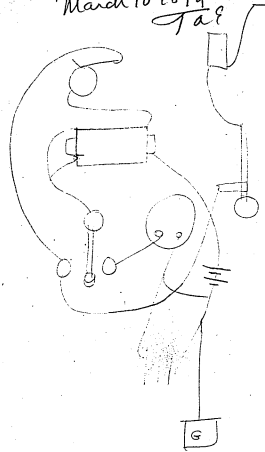

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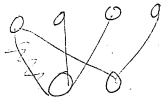

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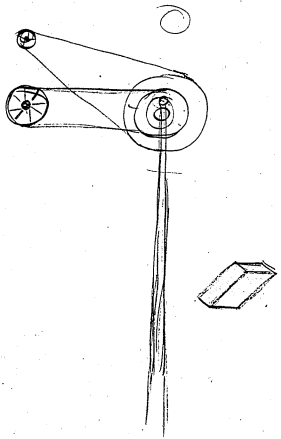
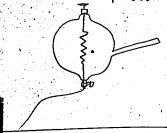
Mchio 1879 Fag



March 20. 1894 [illegible]

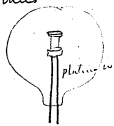
Vacuum Experiments

4 wire - wire common



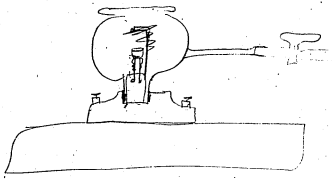
4 of pure iron -
4 " Piano steel
4 " Copper
4 " aluminum
4 " Magnesium
4 " Nickel
4 " $\frac{10}{1000}$ - platinum
4 $\frac{10}{100}$ - pt + gr 10 p.c
4 $\frac{10}{1000}$ - pt + gr - 20 p.c.
4 $\frac{10}{1000}$ - pt + gr - 20 p.c. with Magnesia
4 $\frac{15}{1000}$ - pt + gr - 20 -
4 $\frac{5}{1000}$ - pt + gr 20 - with nitrate Magnesia

2 lime cylinders with 2 layers
1/1000 - Pt on 20 pc pyro insulation 12/1000 -
arranged thus



March 20/19
Ade

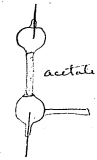
previously brought up in hand pumps -



Two of these -

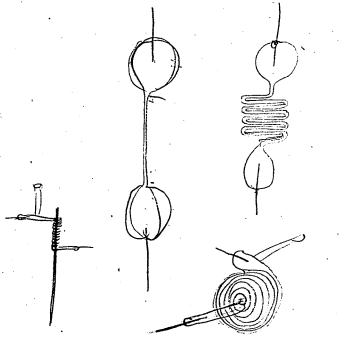
March 20 1879

TAE

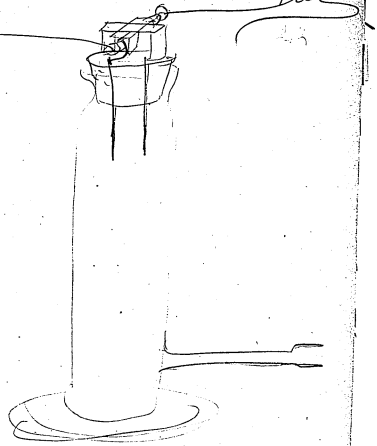


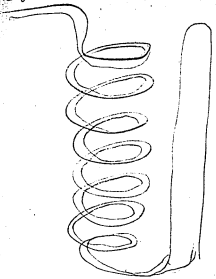
March 20 1894

solid of Revolution



March 20 - 1879 Tate





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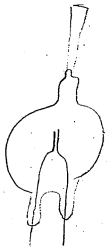
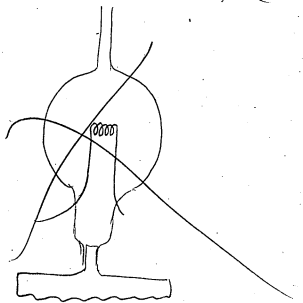


ground joint

3 [illegible] together

March 20 1879

Tait



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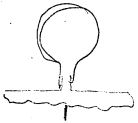

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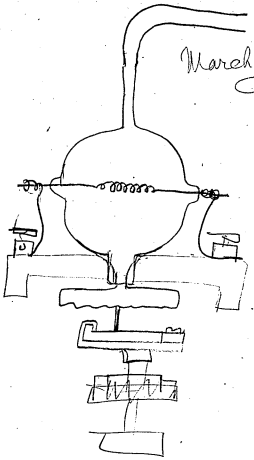
March 20 1809



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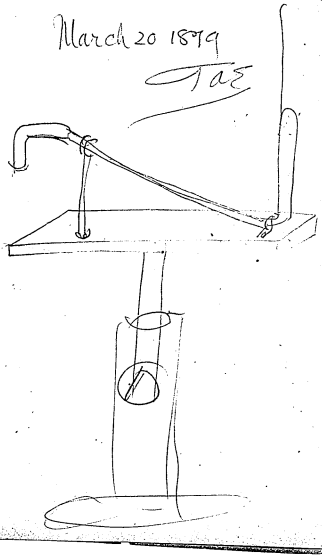
35

March 20 1879

TAE



Apl 1st 1879 37

A E

Platinum Spiral .020 thick.
~~Thickness~~ same as shop lamp, but uncoated and in vacuo.
Splendid light, better than anything we have seen on platinum without coating. Photometer say about 25 candle power.
When heated, it melted beautifully showing on one end a large globule and on other part of the spiral all melted.
Shows a very slight brownish shade of Volatilization

Chemically pure iron
came up to about 6 or 7 candle power. The spiral did not melt clear but where it was connected to the platina

JOE April 1/19

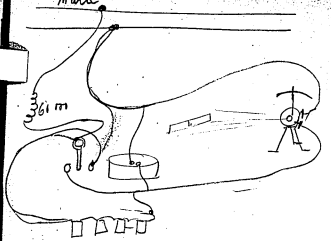
and where the air had not been got out of it it started I think we did not take a long enough time

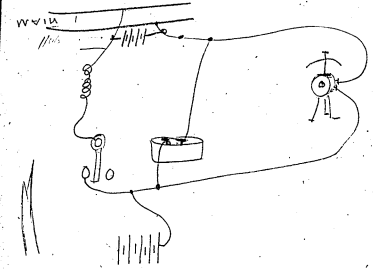
Aluminum

This would not come up at all above a ~~dull yellow~~ when it seemed to get weak in the knees and each spiral showed a tendency to rest on its neighbor

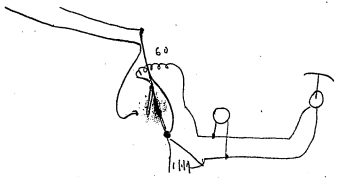
Copper

This spiral was of .012 wire glass cracked when at a red owing to the





3.5 | 3.5 | 8 3 9 0
1 8 9 5
1 1 4 0
1 8 5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14 62

90
87

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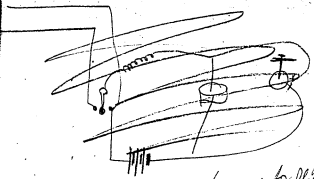
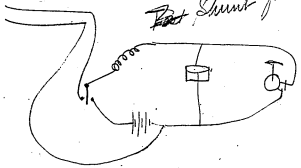
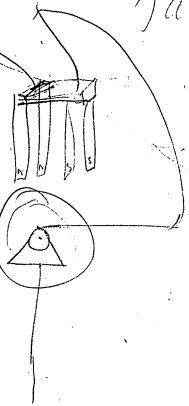


Shunt for regulating



Use cells of 1.48 volts and with 20.
adjust shunt to make deflection
of 60 degrees this make 3° per
volt now take deflection
of current through same and
work by proportion

April 3rd 79 Tag



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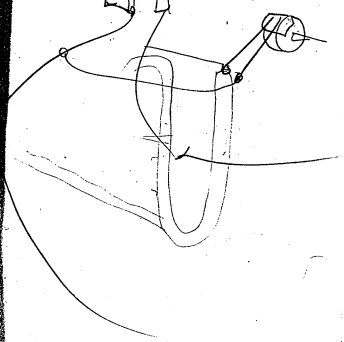

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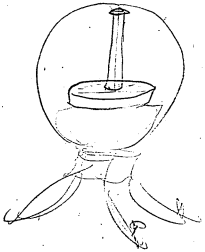
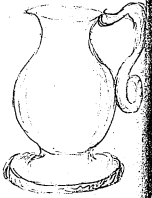
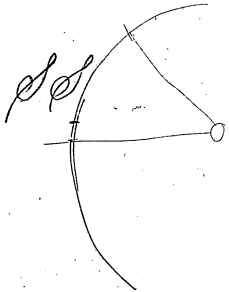




Sunflower regulator for Electric Light



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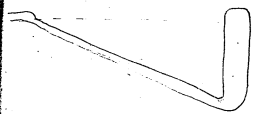
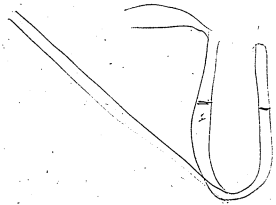
May 30 1879
Jas





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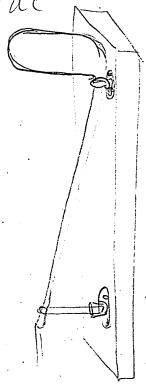
May 31 1879
GAE

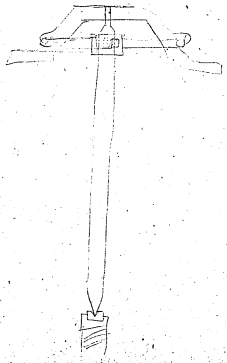


Moulds for Rubber Heels.

May 23d 1879

Tat

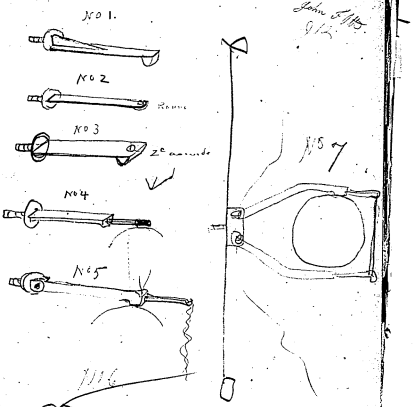
Shaft



60

Induction coil no magnet.

Patterson Chas.



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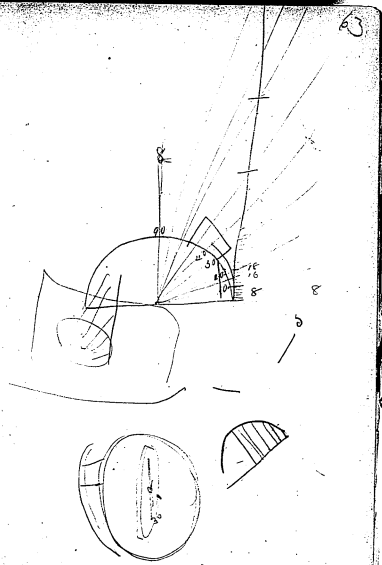
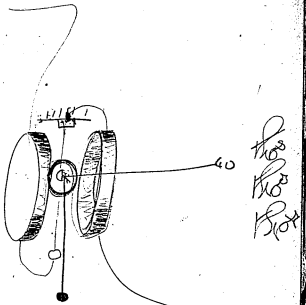
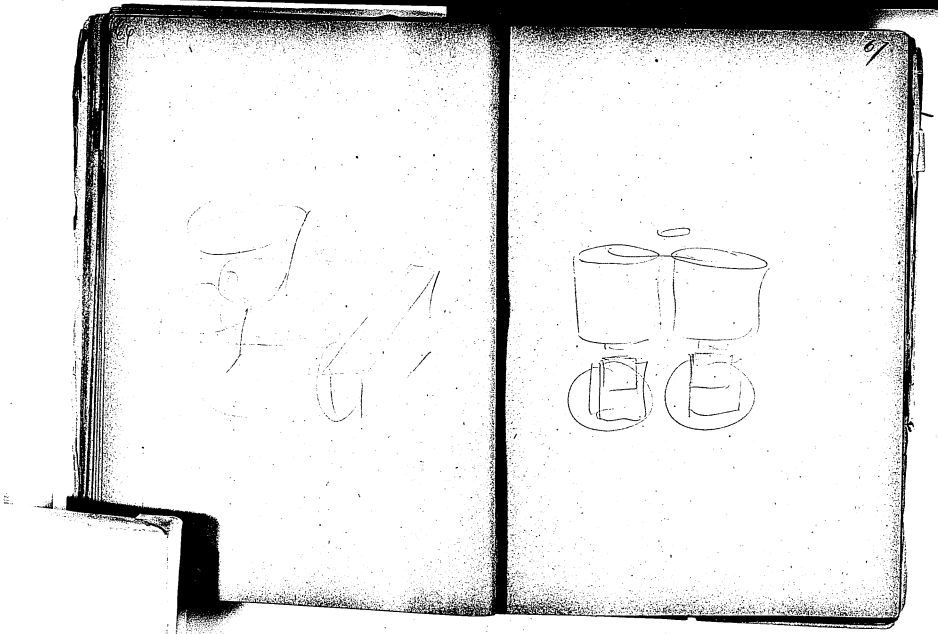






$7.50

3

$100
1.25
5
.625

315
.625

2.5623
1.7959
2.3582

$2.28
1.2
456
228
2.736

1.2

conductors $4.50 per lamps

10 per H.P.
the 1.2 per H.P.

8 per H.P.

hour 9.6 per H.P.

1 ct an hour per H.P.
.125 cts per lamps
per hour

6

$2.28 per years
2.73 per years

45 cts saved

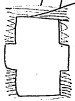
1 arm comes down within
1/2 inch diaphragm

2

Side swing arm
ditto on transmitter arm

66·35
33 1·75

95·5
5
47·5
19·08



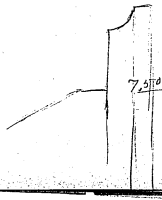
Frame

Rim button between bearings

Make wheels 4 to 7.

Make new pressure spring ~~and~~

Make .128 thick diaphragm



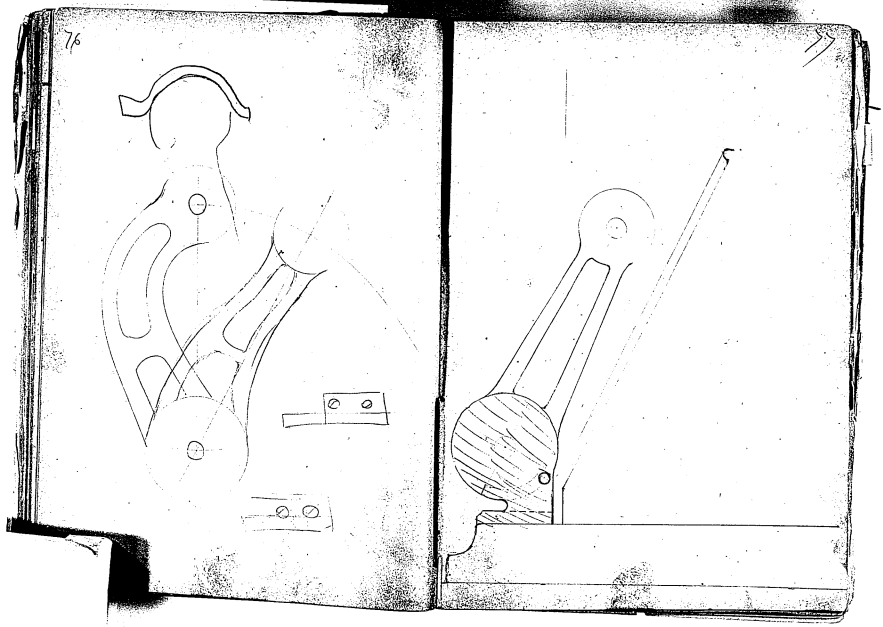
74

Out & I but 2 would do
about 1 oclock look at
rain! they gauge 2 pay 6 x 3 / 33
fits every 6 take 11 / 63
595 / 132
17 / 43
21 16 / 32

620 aw
ok
ok

5

Iron — 19. 0.8
Castam 200 4. 00
Wire — 4. 4. 8
Cotn Wire —
4th 13# Wire
32 Iron Wire
Base
Commutator



78

27 / 938 (34
81
128.
108
2024
24
96
48
576.
144
2304
2304
25344. 858

35.

1 . 25344.
2 12672
4 6336
8 3168
16. 1584
32 792

12600 2
6300 4
3150 8
1575 16

2

1 2 27

27 / 25344 (938
243
104
81
234
216
18.

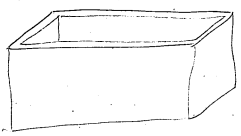
938
170
858,

938,

79

1.
32 (790 / 24
64
150
128
22.

24 30



4

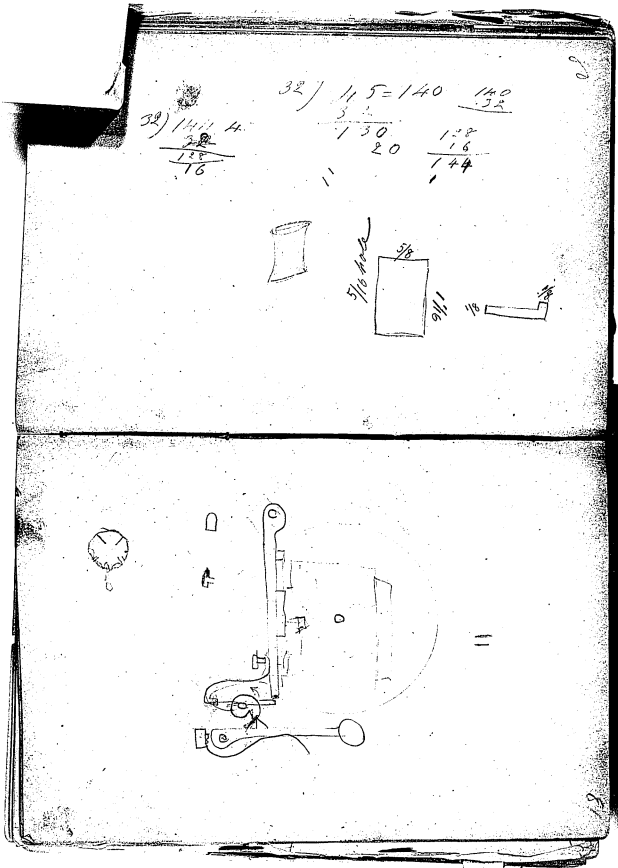
1600

938
27
6566
1876
25326

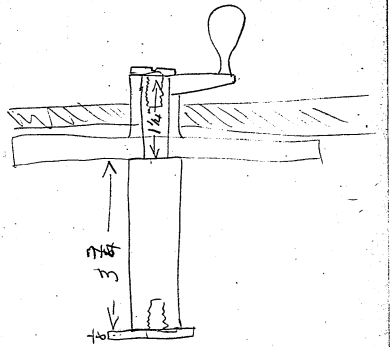
938,

32) 25344 (790
224
294
288
4

730


32) 115=140 140
5 32
130 128
20 16
144
38) 1444
38
144
76
5/16
3/8
9/11
1/8
3/4

82


1/4
予備
3
1/8

86

87

100

$42\frac{1}{2}$

$34\frac{1}{2}$

70 —

85

$42\frac{1}{2}$

1 sr

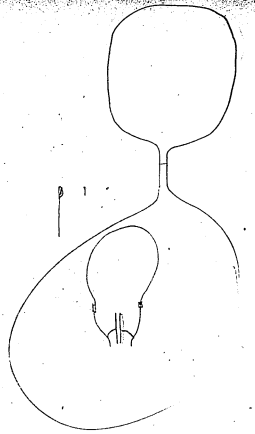
100

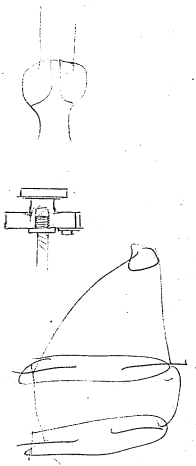
85.

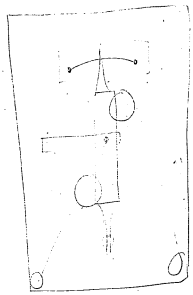
5

7

14.







Modelling Wax:

Rosin
Great deal Starch powder
Beeswax.
Tallow - (Little.)
Orange powder for Color.

1.7
1.7
11.9
17
289

1.6
1.6
96
16
256

3.00

1.5
1.5
75
15
225

4.77
22.85

1.69

.2285
.1505

1.41 .6780

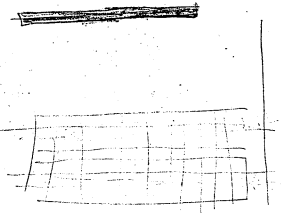
$\frac{1}{4}$ the surface 2 times the light

$\frac{1}{2}$ " " 2.4 " " "

$\frac{2}{3}$ the surface 1.2

1.4 1.

1 1.2 the light



47.7	1.6785
10.1	1.0043
	.6742

4.72 Weeks

47	1.6721
8.21	.9143
5.72	7578
43.2	1.63355
6.15	.7889
7.03	.8466

35.6	1.55514
4	.6021
8.9	.9493
35.1	1.5453
3.55	.55502
9.9	.9951

33.1	1.5198
3.05	.4843
1.08	1.03355

30.2	1.4800
2.5	.3979
12.1	1.0821
22.8	1
2	
11.4	

44 Gas jet

Red 48

Yellow 47

Yellow 48

Higher 48

Very much

3" to inch

3/4 x 5 = 4 1/4 per inch

.045 width

.135

.270

.27

Francis Radiating

3.02 1/2

.045

Francis R. Upton

1/20 .022

1/20 .05

.032 .805

.192 .030

100

122 Ch. Ch.

Ch. Ch

Dr London

625
625
625

468
468
468

101

2 | 625
312

.042
12
.084
4
.336

234

032
6 44
.192 6
264

264

042
12

Jobs 264 264
264 264 264 264
264 264 264 264 264
264 264 264 632

.045
6
.270

5

.234

88

236 | 340736 | 1440
236
1047
944
1033
944
0896

1440
23
4320
2880
3311
20

88
88
704
704
7744
44

4 75,

30976
30976
340.736

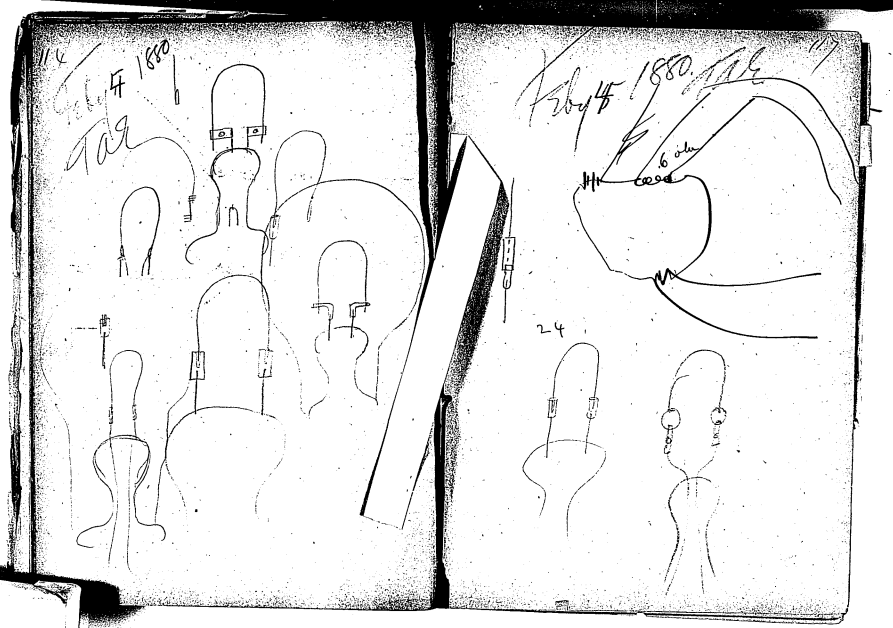
193 | 340736 | 1765
193
1477
1351
1263.
1158
1056.
965

26 | 85

1765
15
8825
1765
26473

1765
18
14120
1765
31770

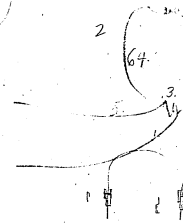
1765
28
35300

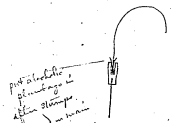

6 ohm
24

118

Feby 4 1880.

TAE

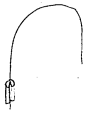




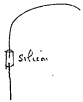
119

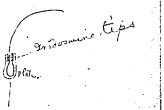
Feby 4 1880

TAE

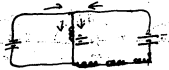


Spirit-wood fibre imbedded in vulcanite Cauoutchouc





Sworn before me
this 4th day of June 1880
C.W. Foster Notary Public



42

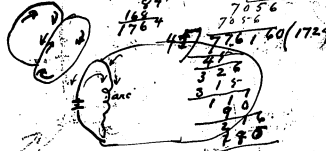
4½'

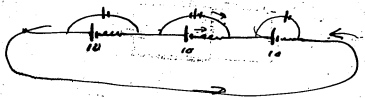
42
42
84

1764
44
7056
7056

168
176 4

45 7761 60 (172 440
45
326
315
110
99
110



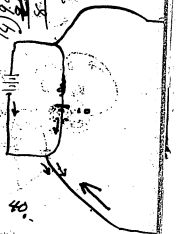


170 000
102 000
170 000
272 000
(3 over)

42
27

14
9

14 18 22 26
4 8 12 16 20 24

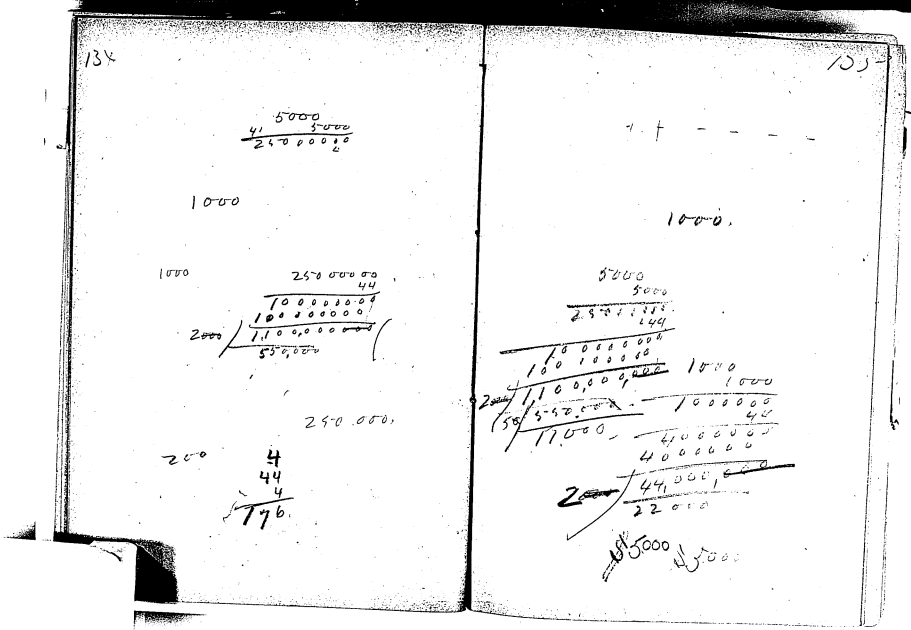


42
42
84
168
1764

33
33
66
132
1089

130 amt for me
is 15 at
1015 wel.

131



156

8.

100

1000

100.

15.

Fortnightly

157

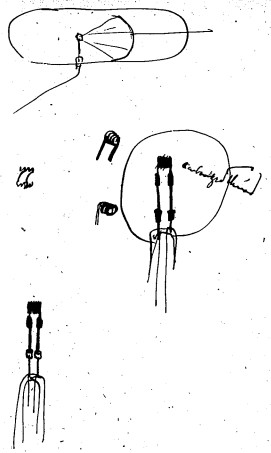
c

800
800
640000
44
256 1000
256 0000
10 | 2816
56 32

160000.

10.

16

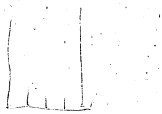


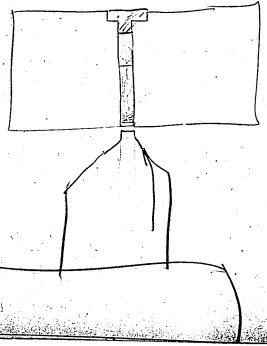
Edison Laboratory Note Book No. 22.

Page 144.

Carbonized Thread Filament.

See Edison Patent:
223,898 (Jan. 27, 1880.)





Edison Laboratory Note Book No. 22.

Pages 148 to 157.

Lamp Regulating Devices, &c.

See Edison Patents:

214,636

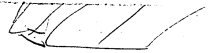
214,637

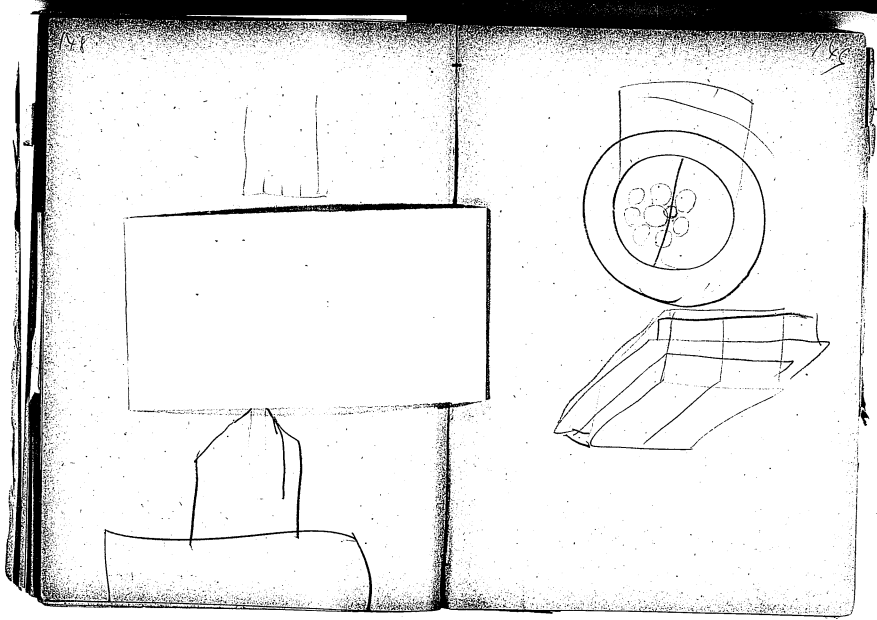
216,860

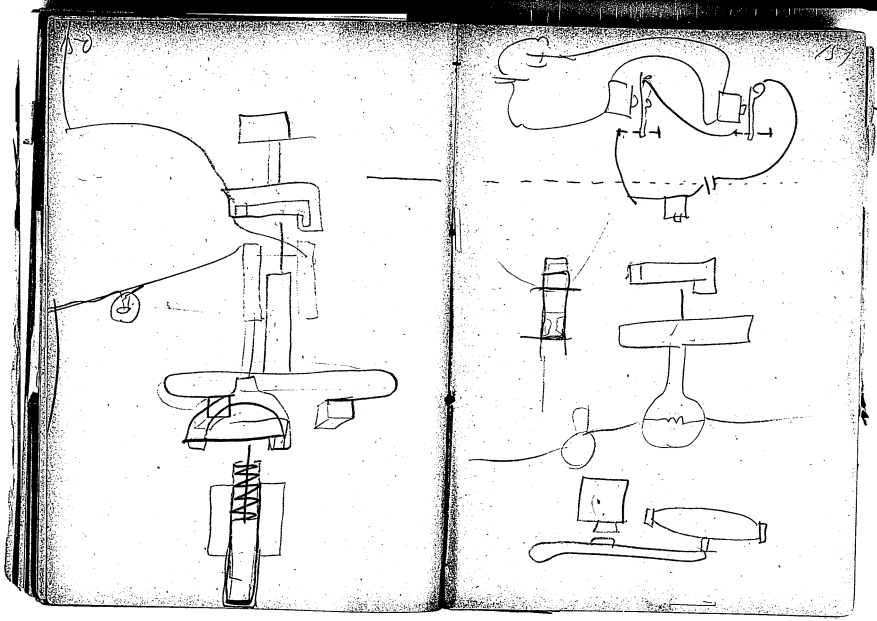
227,207

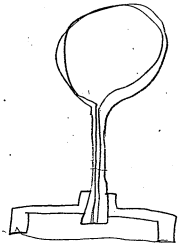
227,238

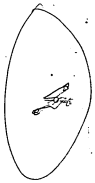
227,239

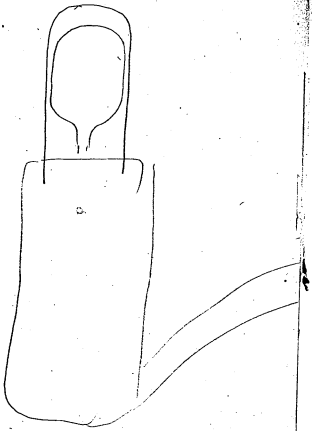


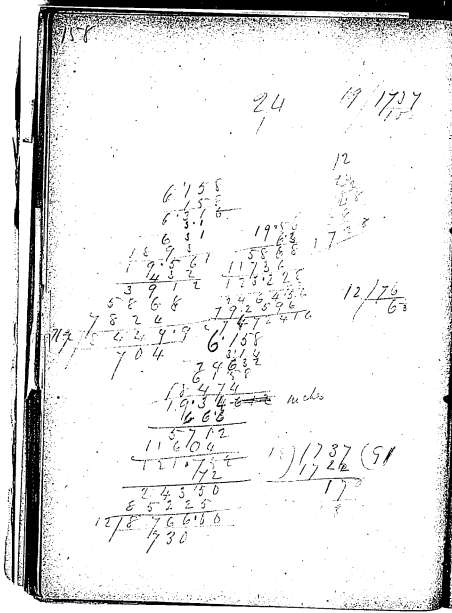






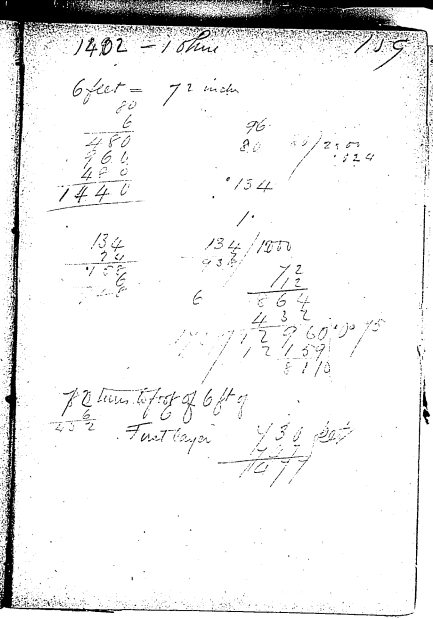


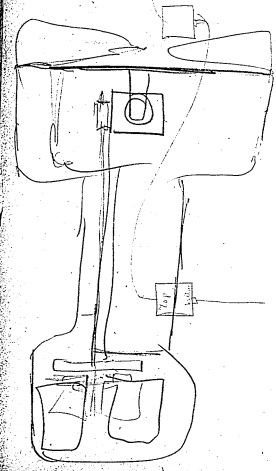


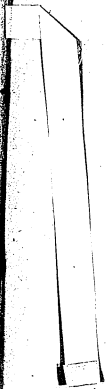


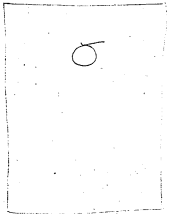
1402 = 1 chain

6 feet = 72 inches









164

1 Pattern for diaphragm ring
2 Body pattern
3 Base pattern
4

4 coffs collard 2 internal 2 external
88 outside 88 inside
4 coffs 2 internal 1 External
176 inside 78 outside,

4 / 4 / 16 / 44 / 64 / 64 / 70 / 4 / 176.

2 / 176 / 88

8

3 / 4 / 4 / 16 / 44 / 64 / 64 / 70 / 4 / 234

3 / 234 / 11

3 / 234 / 78.

78 / 2 / 156 / 78 / 234

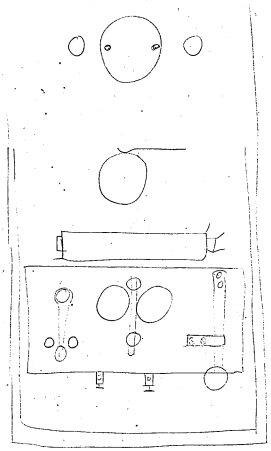
3 / 1 / 2 3 4.

78 / 3 / 234

163

Points in Patterns

1 Recess base for rubber strip
2 Carry rounding on body right round to base
3 Give draught on body
4 Put on knob when handle is
5 Make hinge 1 inch long
6



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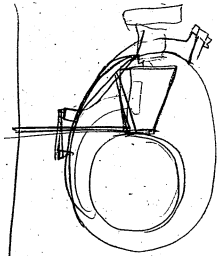

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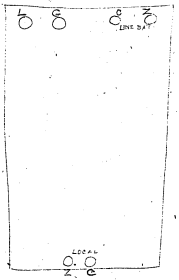
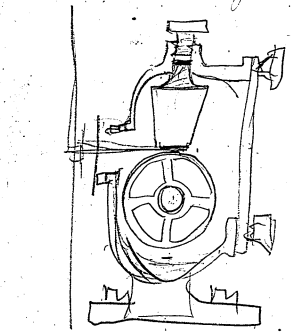
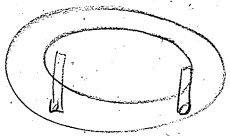
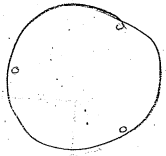


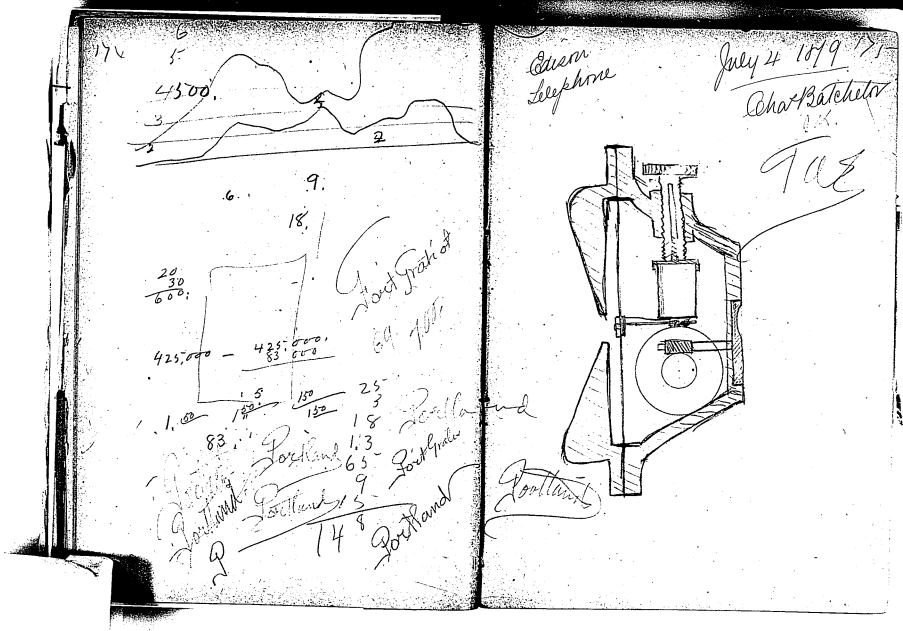
170

Thos Edison July 4 1879
Telephone
Chas Batchelor
Jno Ford

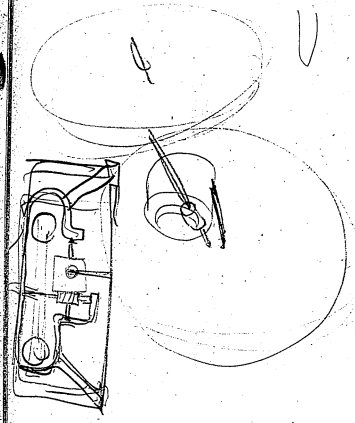







45:00'
Queen
Telephone
July 4 1879
Char Batchelor
Portland
Portland
Portland
Portland
Portland
Portland
Portland
Portland

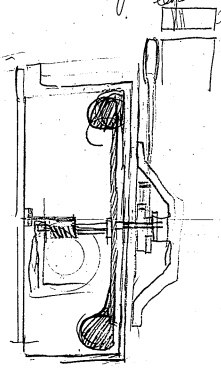
176



Edison Telephone

July 4 1879 177

Edison Watchtelephone

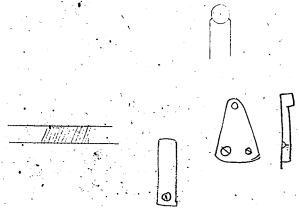


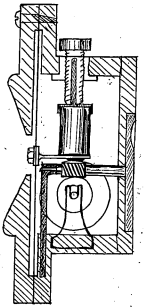
180

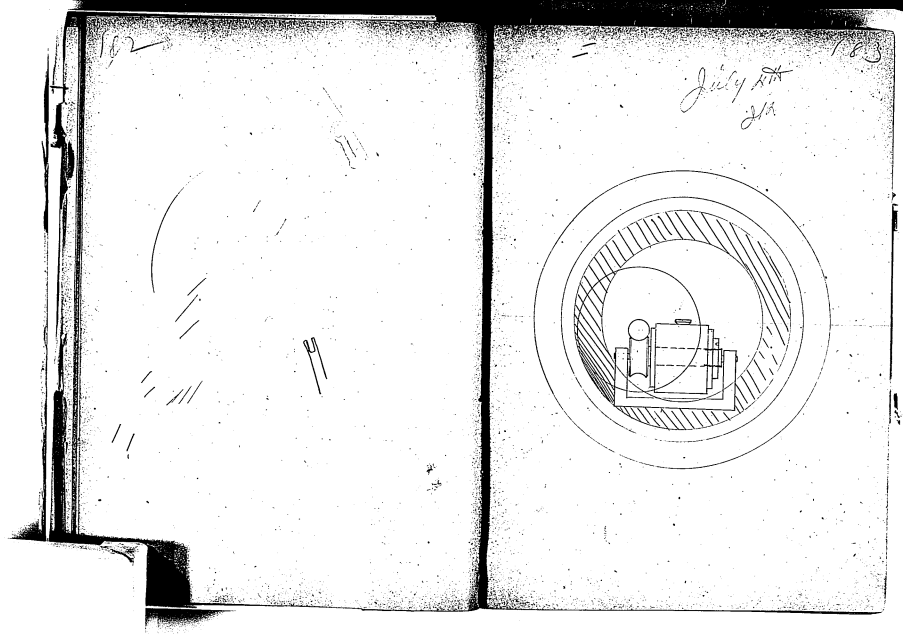
Electric Telephone

July 11th 1879

Alexander Graham Bell







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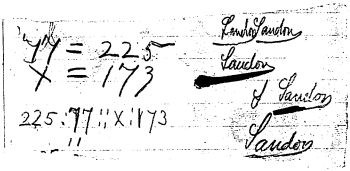

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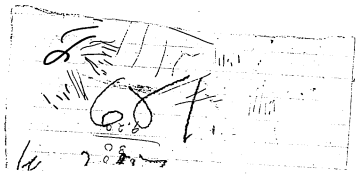
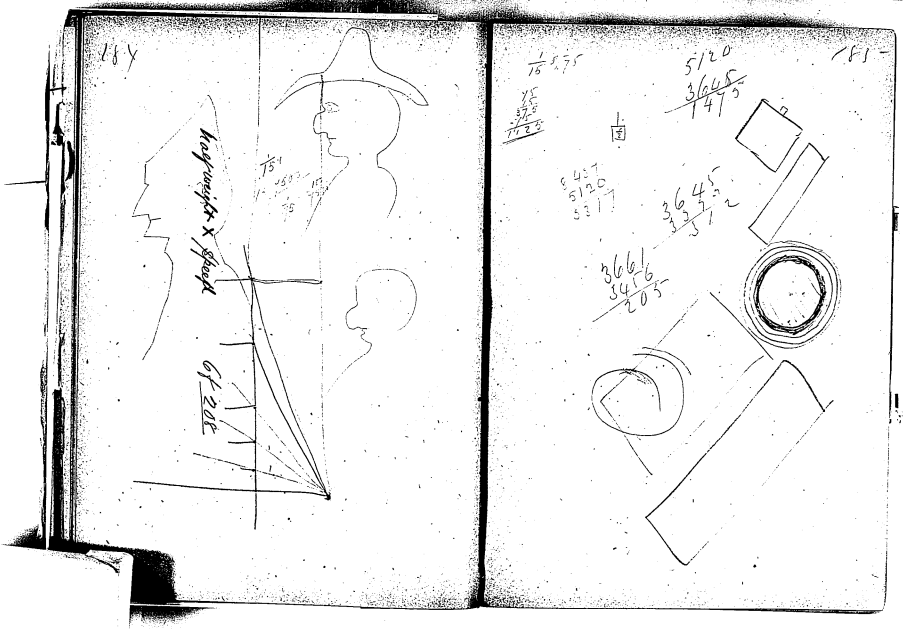
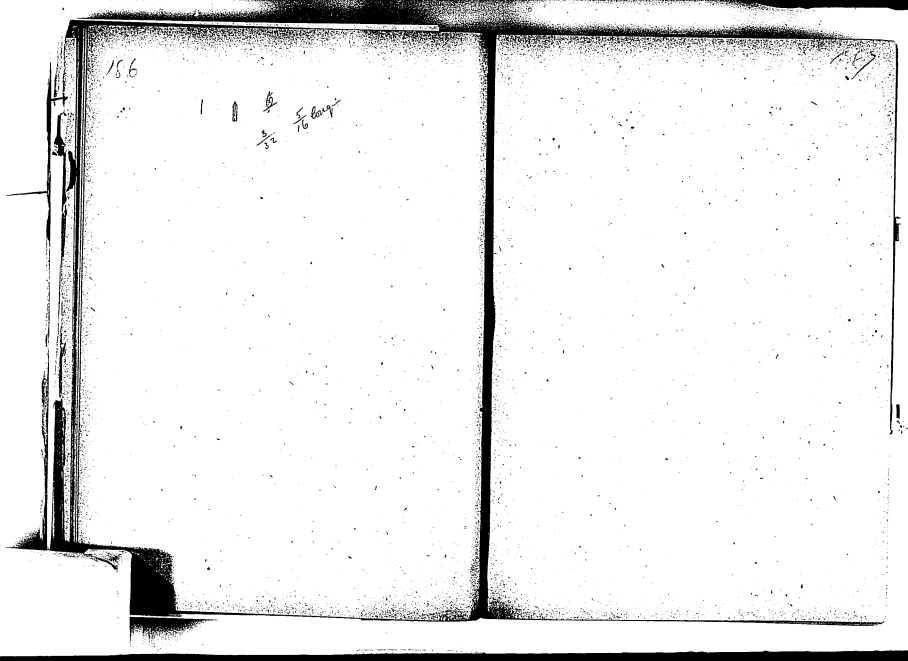
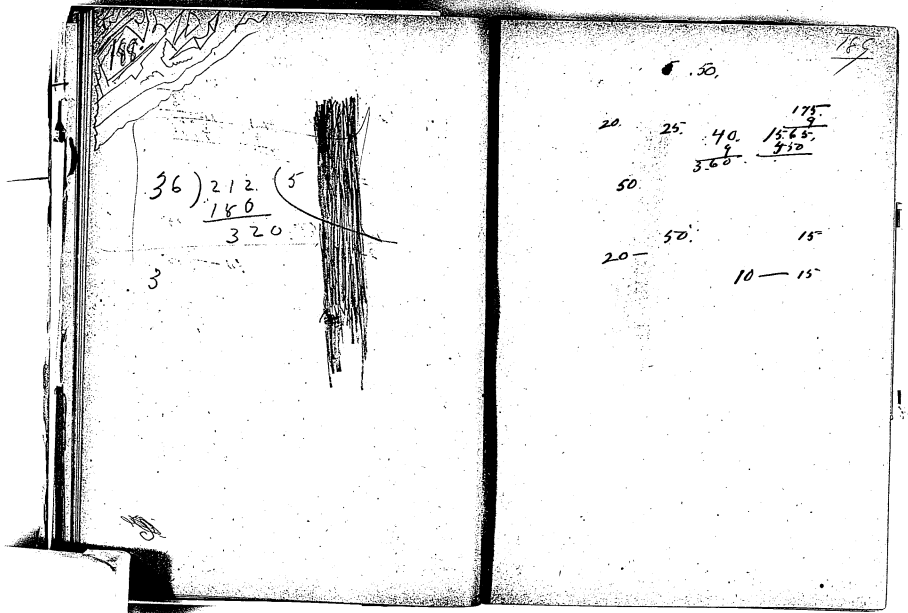



184
Map weight x speed
Gr 2dd
181


186
1 lb
5/32
5/16 long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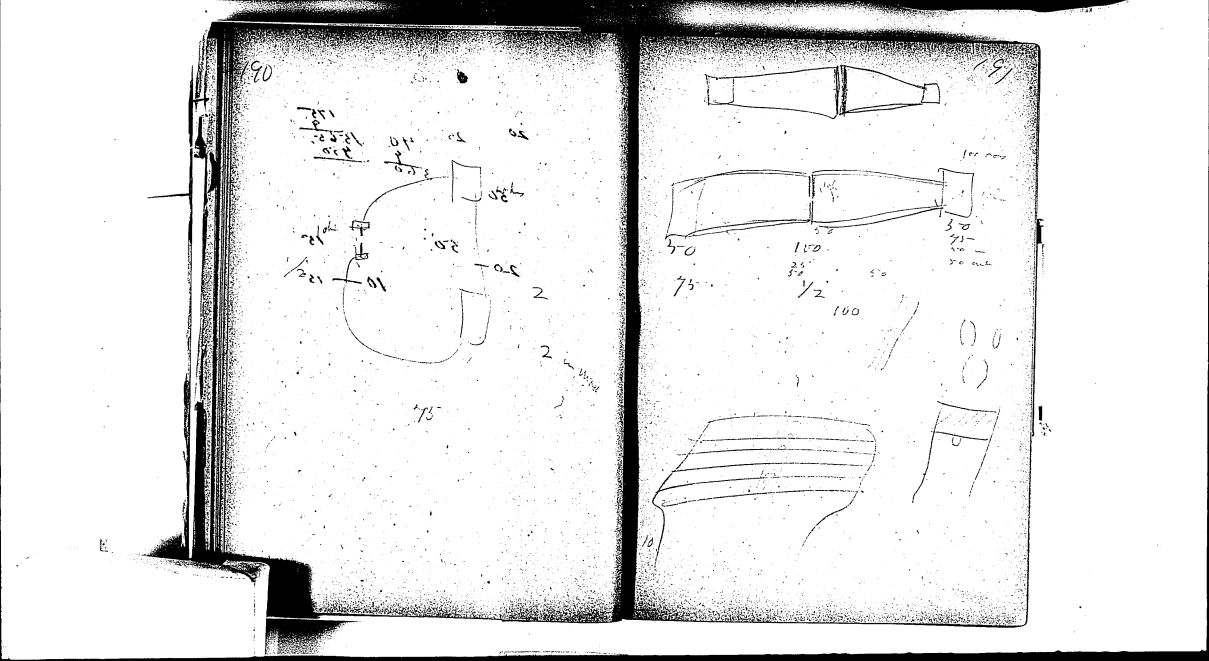

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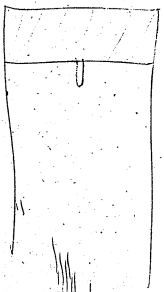

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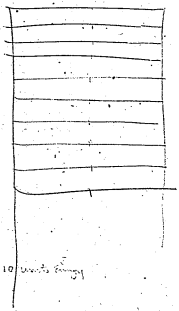
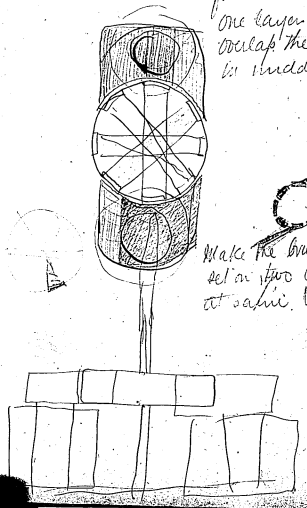


Give plenty of room for the wire as one layer will overlap the other in middle



Make the brush to set on two Commutators at a time

Edison Laboratory Note Book No. 22.

Pages 206 to 209.

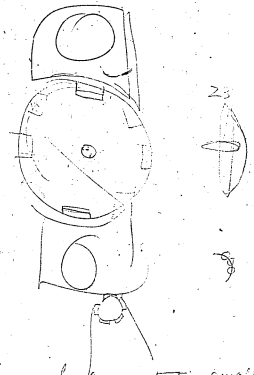
See Edison Patent:
270,201

Make the Commutator small Blocks with small space between

~~Armature~~ Commutators # 8

Coils # 4 Jones & Tyler

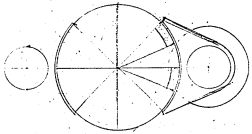
Give plenty of room for the wire as one layer will overlap the other in middle



John Make the Commutator small block with small space between

~~Armature~~ Commutators 8

~~Coils~~ Coils 4 John's 1/35



212

86) 203456 (2365
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184 96
184 96

100) 203456

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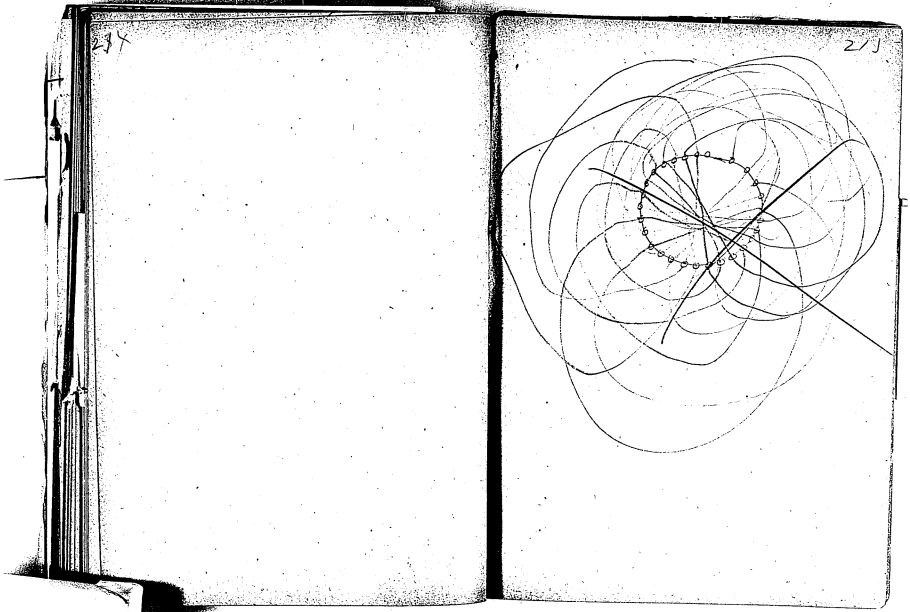

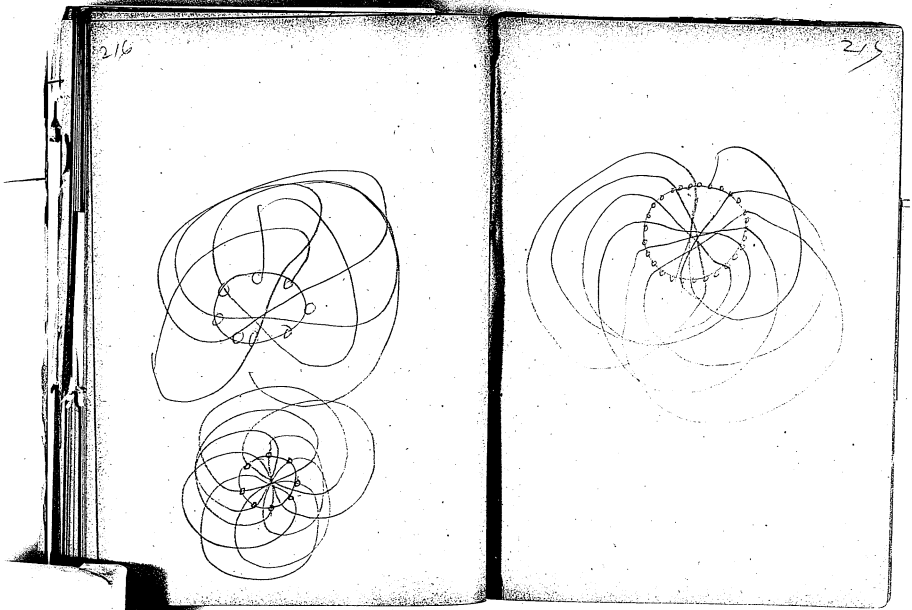
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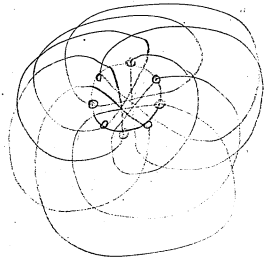
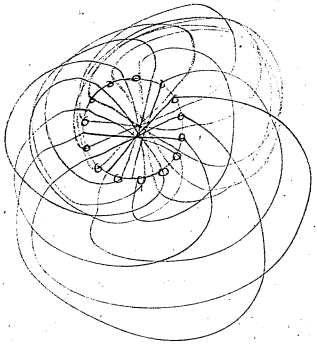
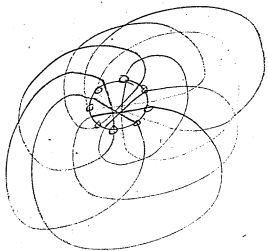
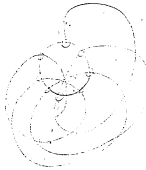
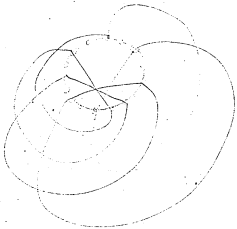
215











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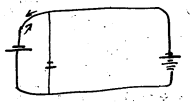

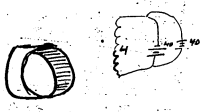

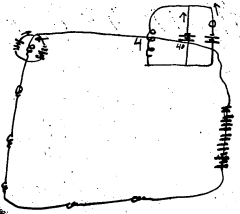

42.46
10.8

45.8

7

1.6274
.0334

1.6608

451 : 82.55 :: 45.8

82.55	1.9167
45.8	1.6609
4.51	9.3457
	2.9233

838 Volts

238

11.05

Spiral war on about thirty minutes, light was about 5 Candels, Res 13 ales

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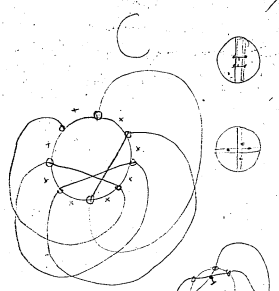
29 | 1025 (35

29 | 29744 (1026 4

74 8 5
164 16 10 29
1645

1025 30 29
170 35
955 145
87
1015



26 1100
26 27
156 7700
52 2300
676 29700
44
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29744

27 | 29744 (1100
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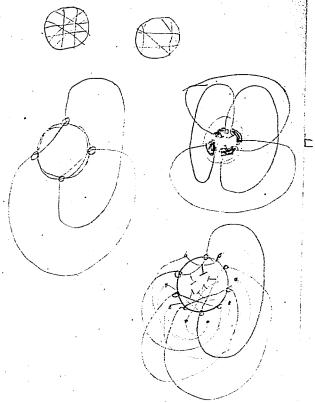
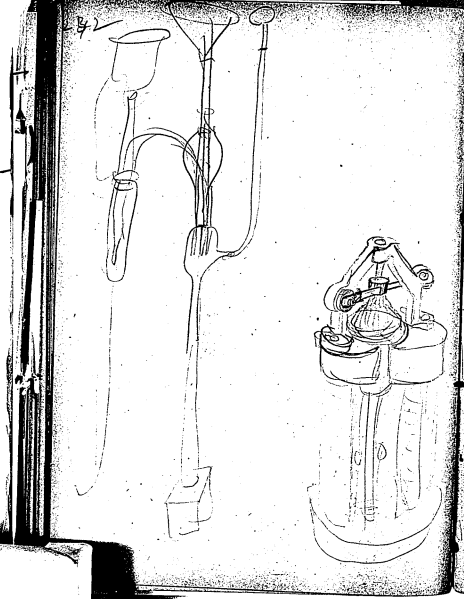
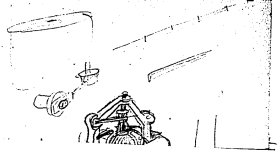
2700

239







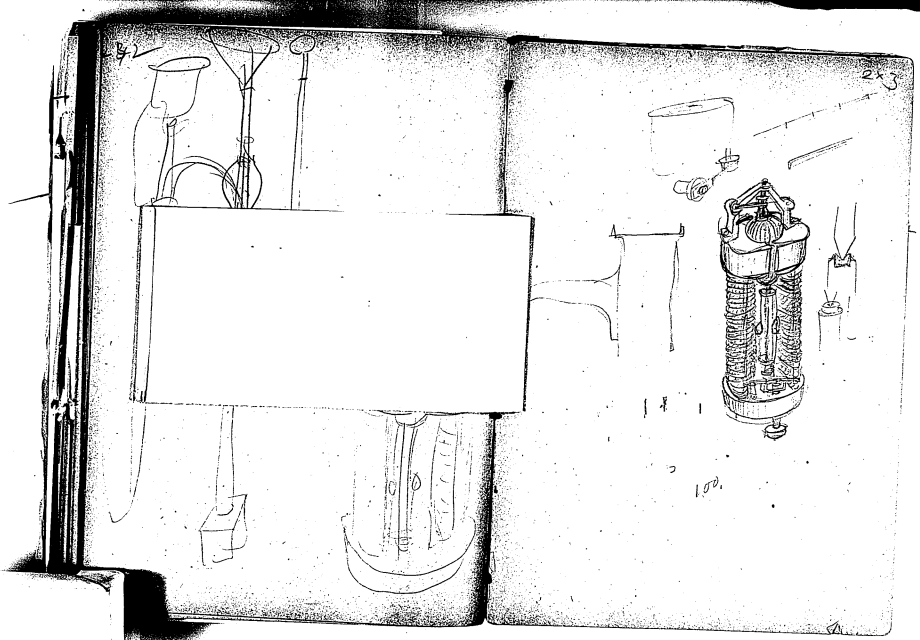
Edison Laboratory Note Book No. 22.

Pages 242 to 248.

See Edison Patent:

272,401

108.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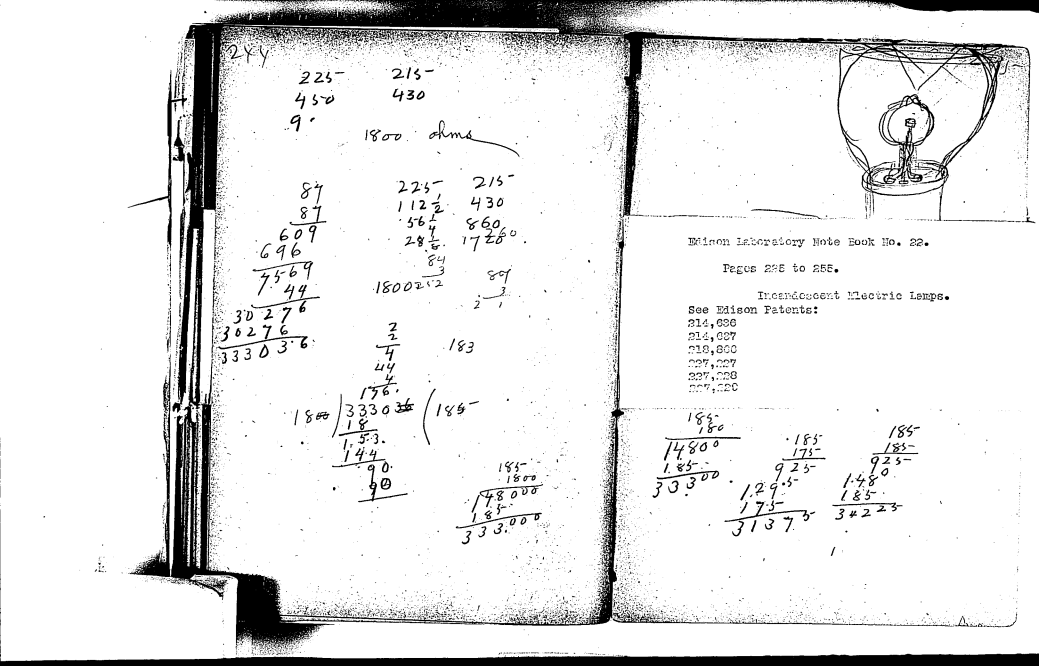
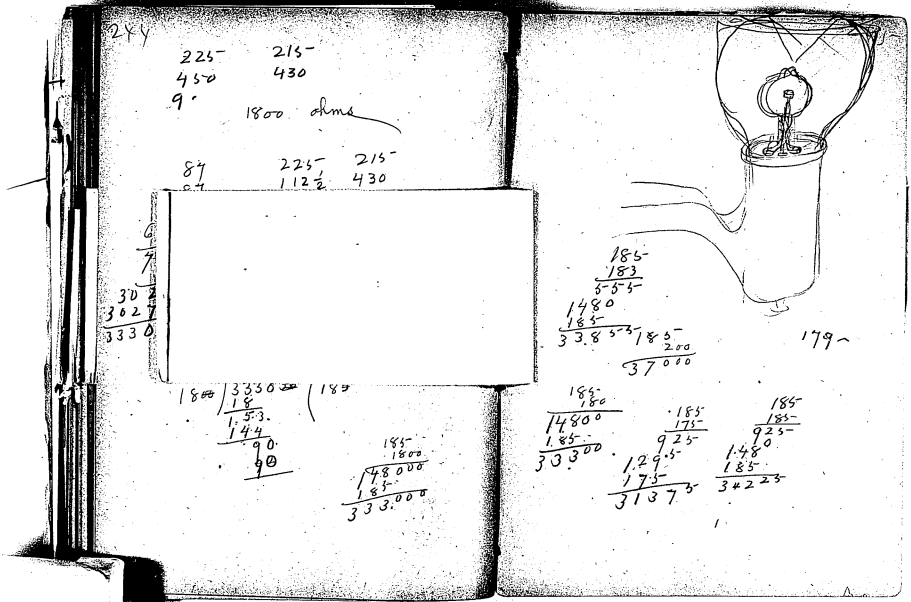


Edison Laboratory Note Book No. 22.

Pages 228 to 255.

Incandescent Electric Lamps.

See Edison Patents:
214,636
214,637
218,800
227,027
227,028
227,220


225-
450
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1800 ohms
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87
225-
112½
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430
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183
5-5-5-
1480
185-
3385-3-3
185-
200
37000
179-
185-
180
14800
185-
33300
185-
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31375
185-
185-
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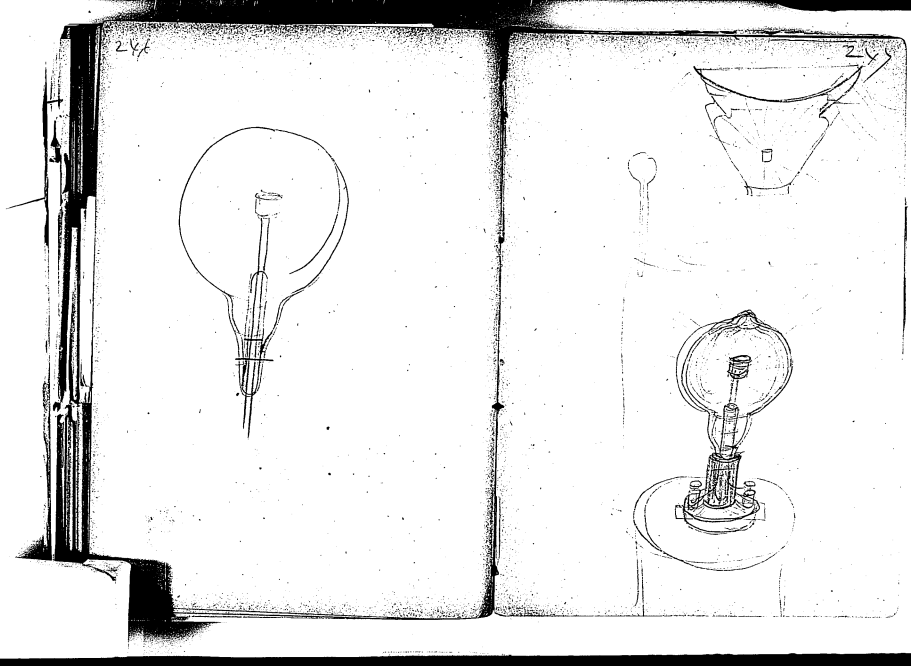

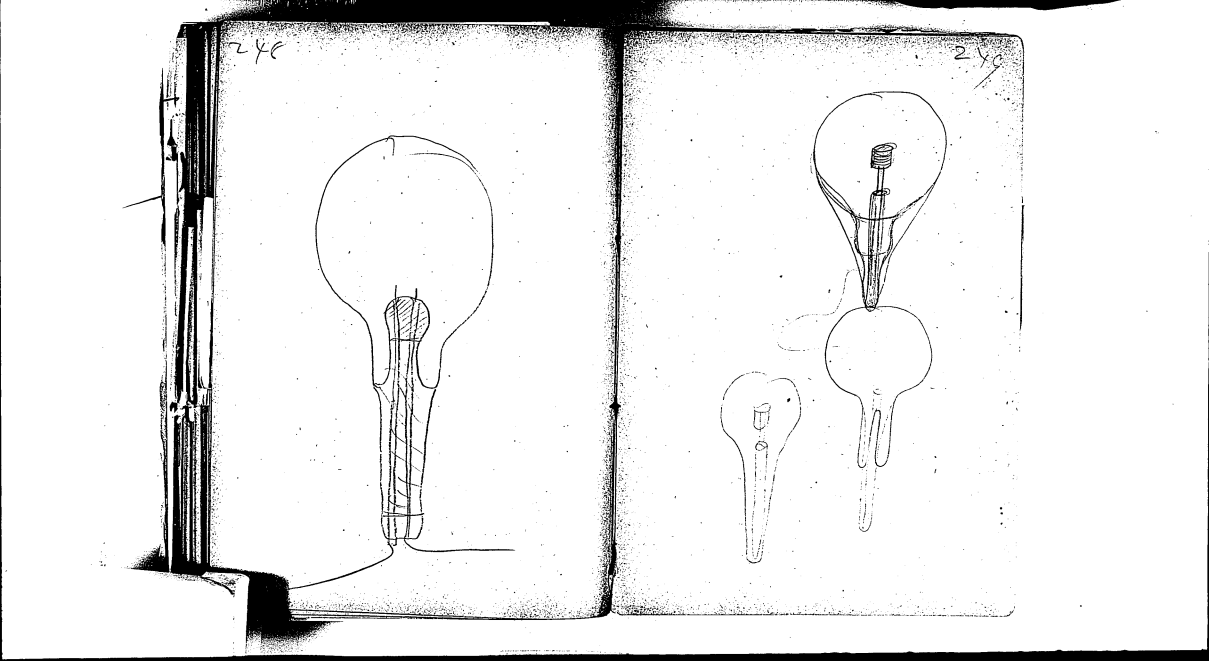

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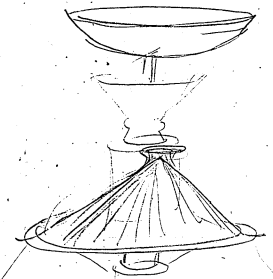

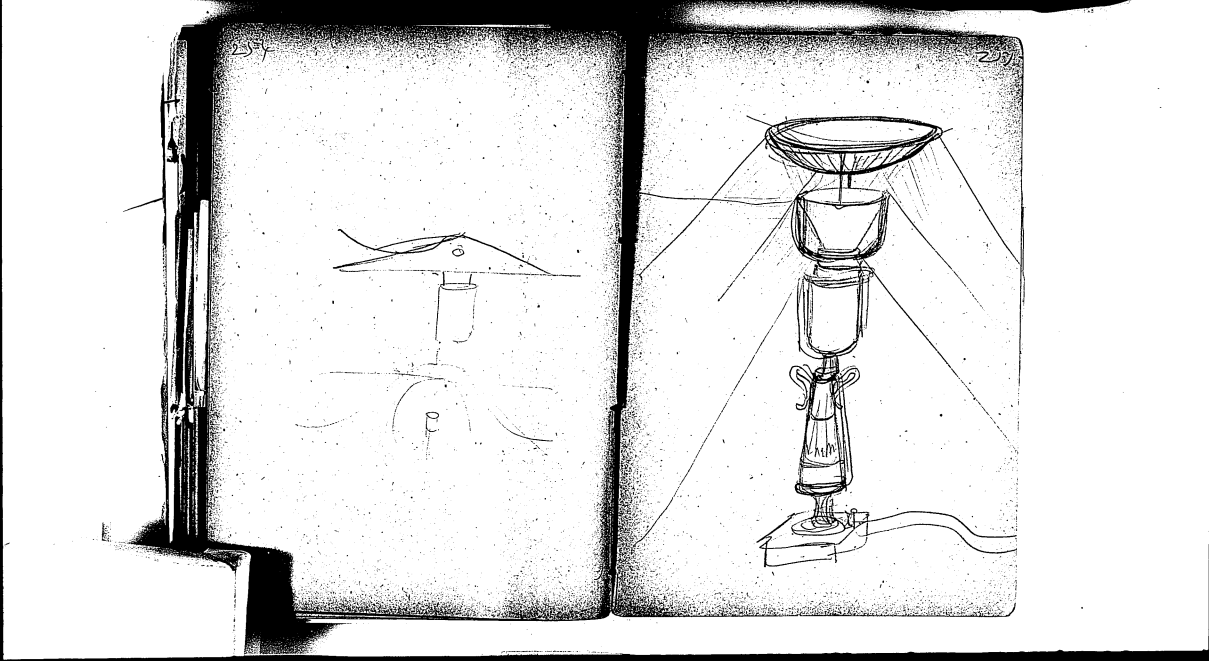

256

217

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64

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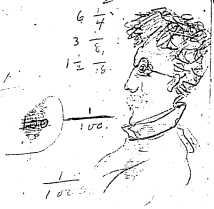
12 1/2
6 1/4
3 1/8
1 1/16



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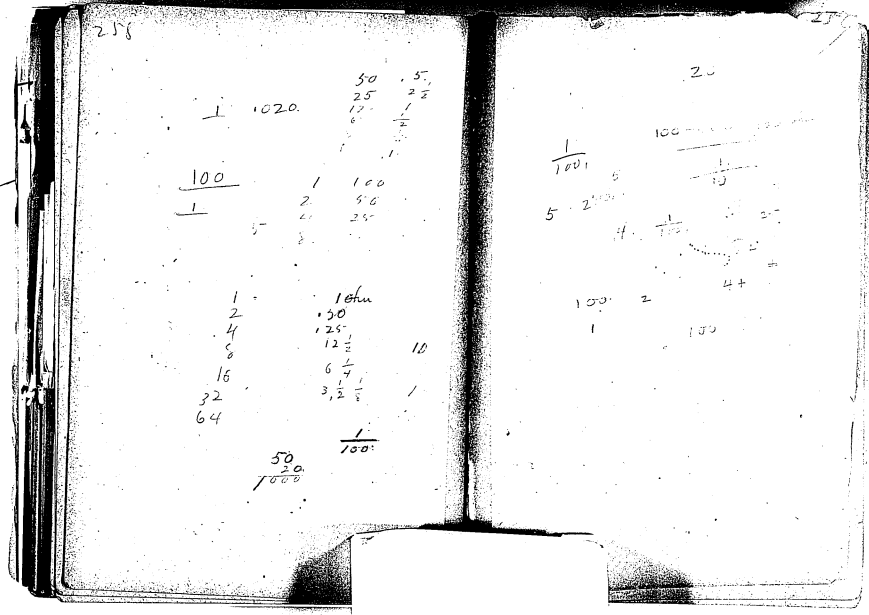
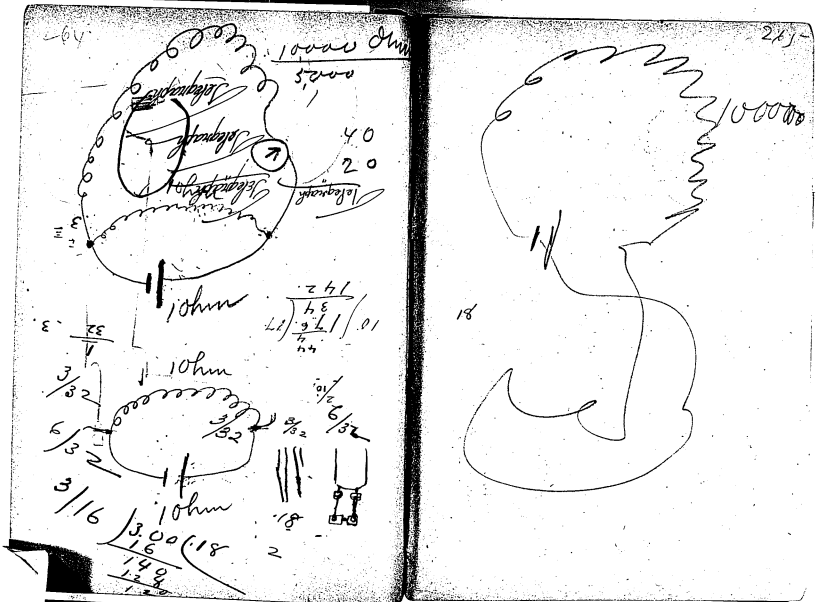


In your last number I see an ~~an~~ communication from a person named weston of newark. ~~How communication~~ to those who are conversant with the subject, ~~it quite sufficient~~ will ~~at once convey to the mind~~

Mr Weston is known as the inventor of a very poor nickel plating Dynamo Electric machine, and lately of ~~an electric~~ another similar apparatus for Electric Lighting. These machines constructed in violation of every known law of both Electricity & Magnetism


10 ohm
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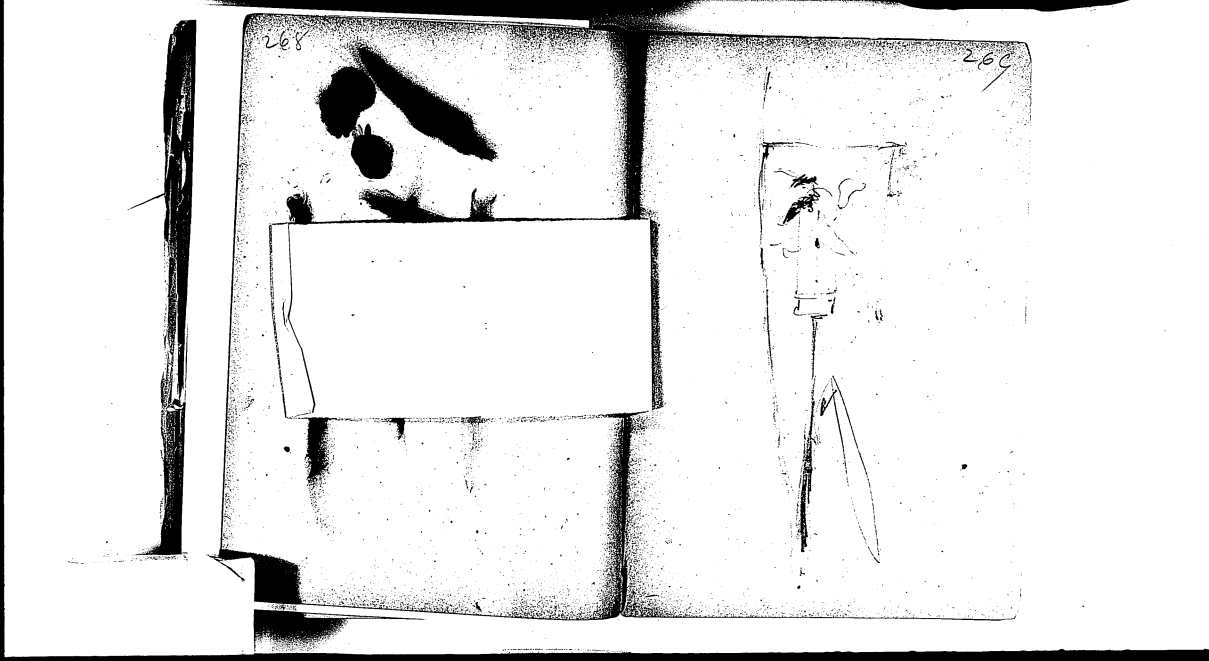
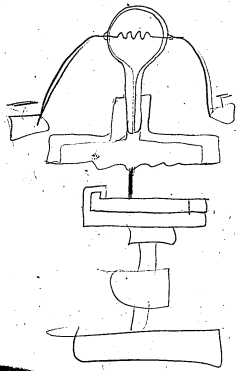
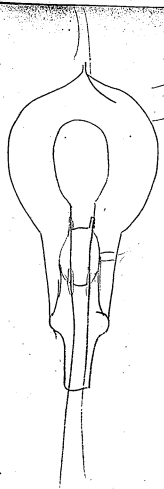
6/32
18


268
269





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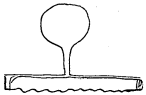

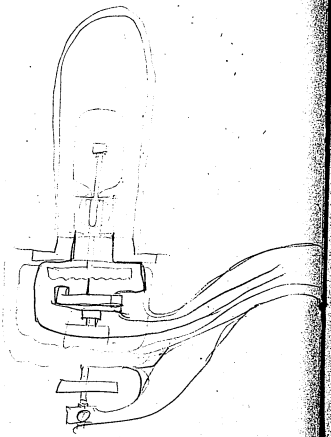

Dunn

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9.294

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8.706

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.281

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31
.531
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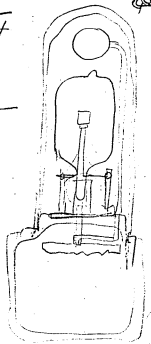
1.062



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9.22
8.706
.514

4.721
.562
4.159
2
8.318

9.500
.031
9.469
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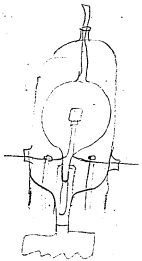

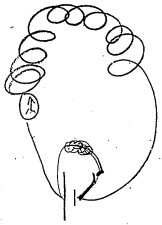

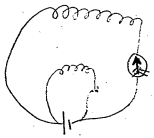

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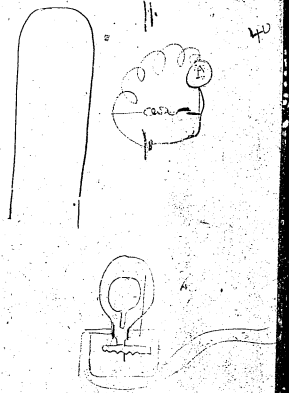

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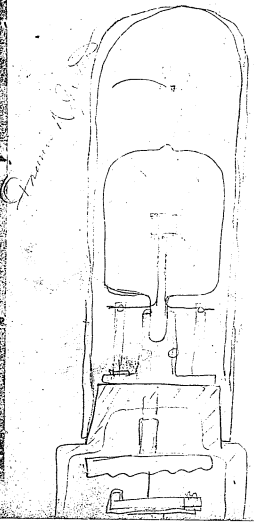
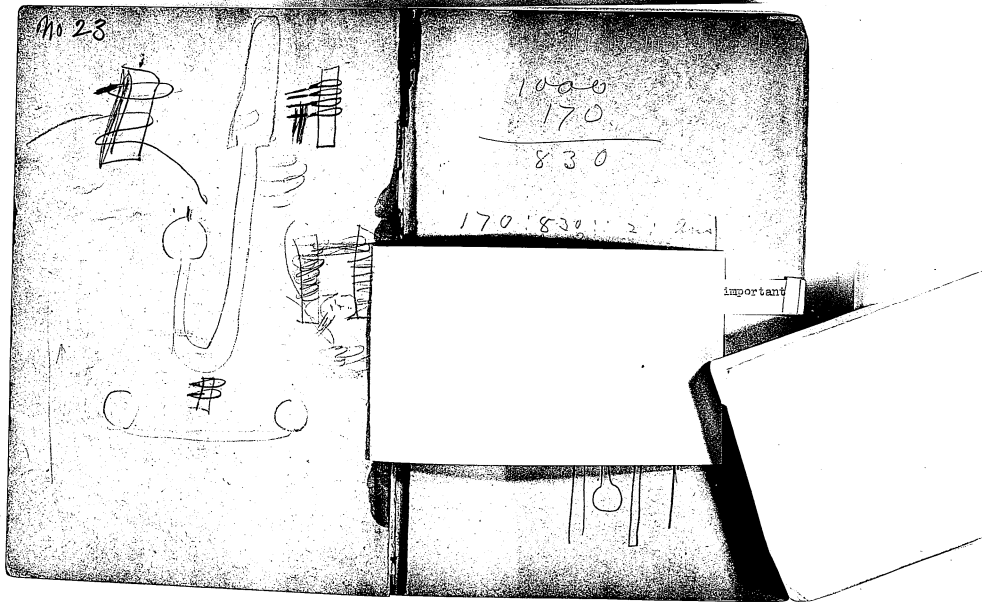


Menlo Park Notebook #23 [N-79-01-19]

The dated entries in this notebook cover the period January-February 1879. The earliest entries may be from December 1878. Most of the entries are by Edison, Charles Batchelor, and Francis Upton. There are also entries by John Kruesi. All of the material relates to experiments on electric lighting. Included are notes on metals for filaments; calculations and drawings of generators; and notes and calculations about electric power distribution systems. The book contains 152 numbered pages. Following page 33, the left-hand pages are unnumbered.

Blank pages not filmed: 20-21, 24-25.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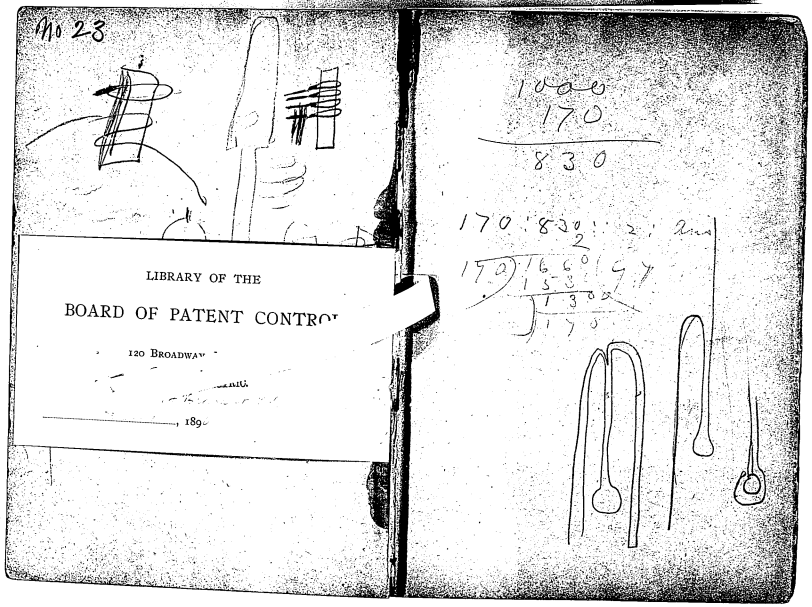
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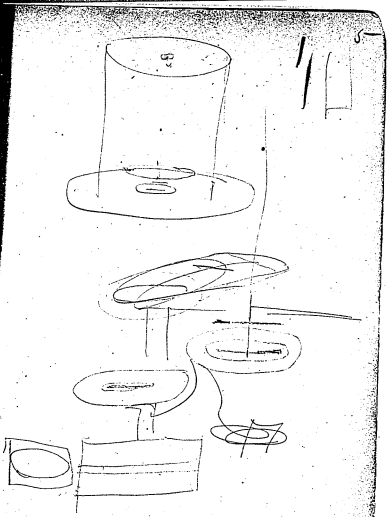

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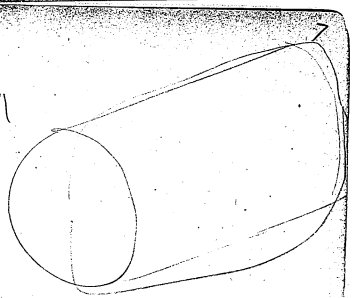
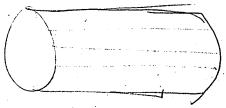
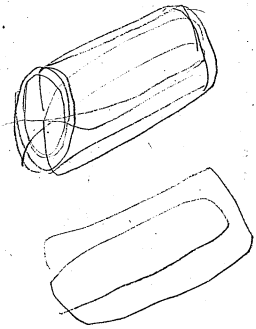
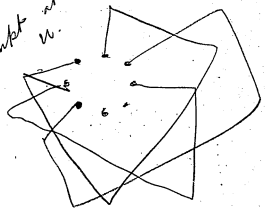
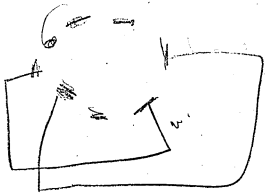


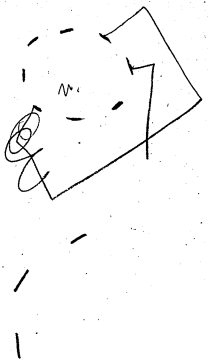


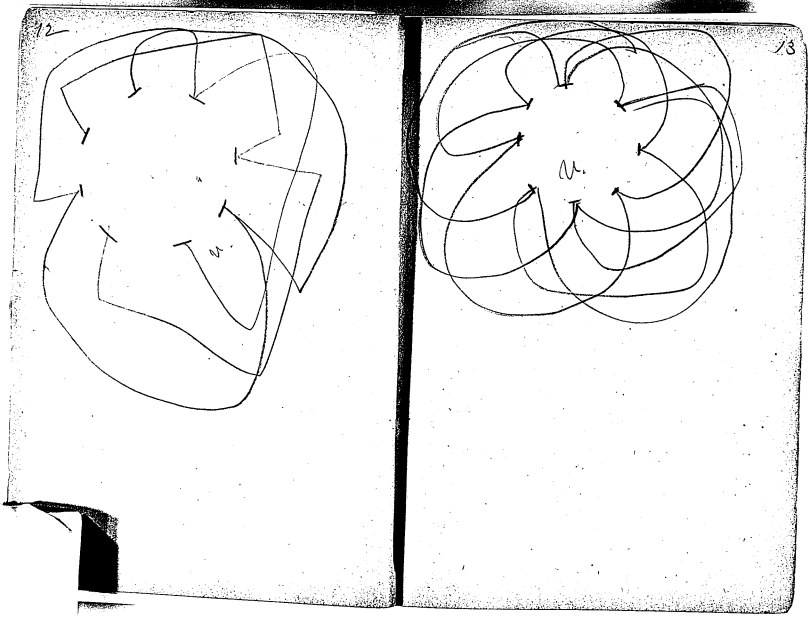


Attempt at Gramme !





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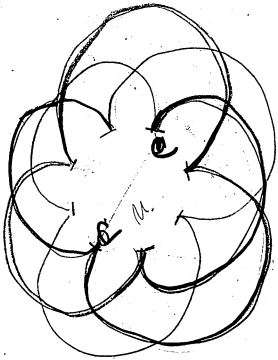

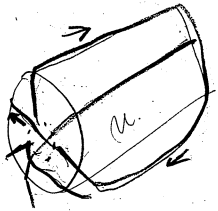

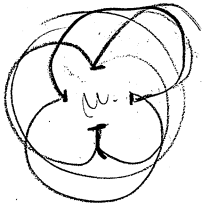

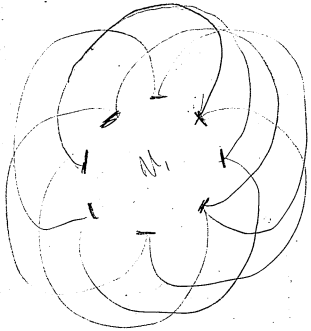

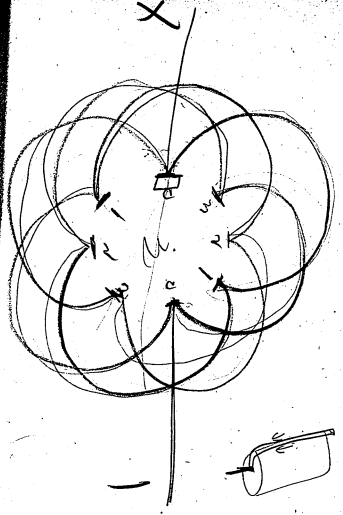

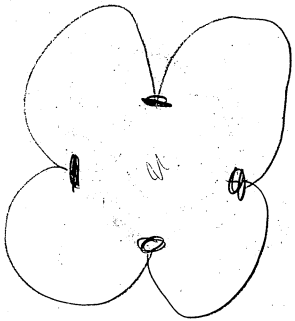

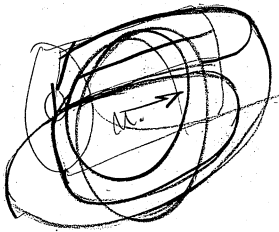

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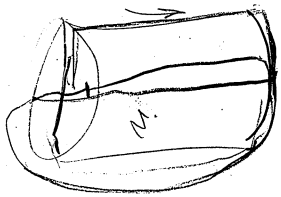

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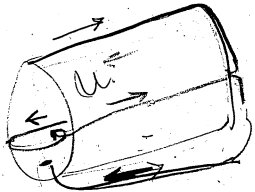


Resistance of ring 25 Ohms
field mag 50 Ohms

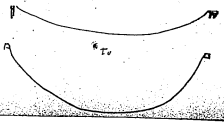
75 Ohms
75 Ohms
150
75

Ex
50
150 = 1/3

Experiments with Platina & Platinum-Iridium alloys 20 per cent Ir- at the incandescent point with galvanic Gallery to determine any changes that may take place.

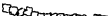
Menlo Park NJ January 18-79

Platina wire .004. does not permanently elongate to the extent that the pt-Ir-alloy does, the latter is very soft at the incandescent point so much so that with .004 Pt-Ir wire 20 pc is unable to support its own weight when placed horizontal between supports 80 mm. apart. it slowly bows downward from a slight curve thus

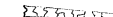


It has not anything like the strength of platinum
even at the same temperature.

When the Pt-Ir wire is allowed to remain
incandescent for 30 minutes a remarkable
change is effected It stretches, grows smaller
in diameter (10) from .004 To .003. & breaks
upon examination under the microscope it has
this appearance



Platina wire thus



If the platina wire is only brought to incandescence
for say 2 minutes it shews these cracks

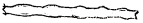
they first are not open but just as if a mole had been burrowing around the wire, after a longer time these break + sharp edged cracks make their appearance;

=

when the Platinum wire is fused after being cracked the press upon the end when it does not break off short has this appearance;

Just before Pt or Pt-Ir wire fuses between the supports it contracts violently and the

cause is apparent when we place it under the microscope. it has drawn up into globules if it breaks quickly the globular tendency is just perceptible but it it contracts considerably before breaking these globules a plain



To ascertain loss of weight we placed 005 pt wire in supports weight 0.0296 gramme. in 5 minutes we raised heat so it fused upon weighing the whole it was 0.0293.9 showing loss .0003. gramme.

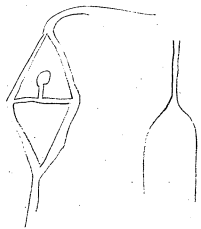
Another piece weighed .0.0266. after being measurement for 20 minutes it weighed 0.0265. showing loss of .0001 .9. at

this rate it would all be dissipated in 122 hours, but organic matter may account for some of this loss.

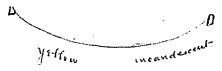
The same piece was then made incandescent for 20 more minutes and weighed 0.0262 grammes shewing a further loss of weight of 0.0003. or a total loss of .0004 gramme.

after 10 minutes more we again weigh it and find weight to be 0.0260 shewing a further loss of weight of 0.0002 or a total of 00006. gramme.

After 20 minutes more we again weigh it and find its weight to be 0.0258 shewing a further loss of 0.0002 or a total of 0.0008. gramme.



Yesterday I noticed a peculiar phenomenon
" when the platinum of coil wire was placed
between the supports 60 mm apart and
brought to incandescence for 1 hour
a portion only was incandescent after
the lapse of that time. Thus



With large Eaton spectroscope no lines were
visible, but perhaps if longer wire were used
lines could be seen - It is barely

possible that the platinum is contaminated with osmium, Ruthenium, Rhodium or other more oxidizable metal of the platinum groups - or that there is an immense amount of oxygen condensed in the platinum which is driven out by the heat,

I think that I smell ozone coming from the incandescent wire, at least the smell is peculiar,

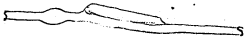
Another hypothesis is that chloride of sodium in the air combines with the Pt to form a volatile Pt chloride,

I find that the 001 wire made (Pt) by Johnson Matthay & Co London melts in the ordinary gas jet - under the Microscope it shews all broken up in short lengths and clearly fused at these breaks

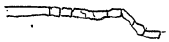
a piece of wire held in the flame bends with a jerk thus

with wire 002 made from Raynors pt. it fuses readily but these short breaks are not so perceptible as in J M & Co wire. all the breaks are smooth

thus



whereas Y M wire



with Rayons of 010 pt. after 6 secs incandescent 5 minutes on battery, showed fine cracks just commencing. but the sections bounded by the cracks were very much smaller than Jm.t.Co small 004 wire,

I now put in 010. 10 p.c. Pt Zn - JM+Co wire, - taken out and experiments

resumed with the piece which we have repeatedly weighed-

I notice that this piece does not drop or bow downwards nearly as much as it did when first put in- There is just 70 mm of this wire, after 3 minutes I notice it commences to drop considerable -

=

With platina wire I notice that the heating always commences exactly in the middle of the wire and reaches towards the two supports simultaneously but the action is not so rapid but that the eye can easily trace it.

J M & Co 005 platina if held in gas flame for 30 seconds shews cracks under microscope; also little round raised

drops as if gas were underneath but tension was insufficient to burst the bubble.

= heated air can be seen rising from 70 mm of 004 wire 2 feet over it =

The 0.0266 wire after resubjected again to incandescence for 20 minutes weighed - 0.0252. showing a loss since last weighing of 0.0006 or a total of ~~0.0014~~ .0014.

It was again made incandescent for 20 minutes & weight found to be 0.0249. showing loss of 0.0003 or total of 0.0017. The wire fused.

we now take ½ of this fused wire which weighs 0.0132 grammes and subject it to incandescence, again for 60 minutes continuously -

note - I notice the wire although growing smaller keeps perfectly bright.

The loss in 60 minutes 0.0130. or 1.0002, This loss is not very great but may be due to the fact that I put a book up on one side of the wire within ¼ inch of it to shield it from air drafts which cooling it in spots raises the temperature of the rests of the wire by reducing resistance & this tends or sometimes causes fusion

32.

we again put the wire to the incandescent point for 20 minutes. It weighed

note. I did not succeed in fusing the 001 wire in flame from burning paper though it became incandescent.

afterwards .0129. shewing loss of .0001

after 20 more minutes of incandescence it weighs .0.0129. shewing No loss

The scale (Beckers best) does not work as sensitive as it should be. We again put it to the incandescent point for 20 minutes and I take the book down to allow draughts of air to strike the platinum as it is not highly incandescent and if the action is due to oxygen this will hasten it. we weigh & find no loss -

we again bring it to the incandescent point, slightly higher than before for 20 minutes – we weigh and find NO LOSS I now at 7 o'clock pm bring it to incandescence to be left all night.

Menlo Park. Jany 20=79

Found that battery had run down on platina coil. It probably kept incandescent for 2 or 3 hours then by midnight became inoperative we find at 8.30 am this morning on weighing that it had lost nothing = We again bring it to incandescence for 1 hour. note – I notice a flash of smoke go off when the Pt was heated this morning showing that dust had been deposited over night. the weight

must have been very small,

after one hour it weighs no less

note - The whole loss of this piece with the one broken from it amounts to 8.4 per cent. 4 hours & 20 minutes then stopped heating — one hour more no change.

I placed a piece of Pt-Ir 10 per cent foil in stand and brought to incandescence for 2 minutes, under microscope - it showed slight cracks thus.

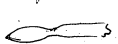
and some of the surface of the foil bounded by these cracks showed a tint of iridescence.

I again brought the foil to incandescence for 5 minutes, under the microscope the

cracks were large and spotted all over with
sections that were viridescent. thus

This shews oxidation and I think it is Iridium
often causing it to become incandescent for
5 more minutes. These viridescent spaces lose
their fine appearance and approach that of
the viridescence of lamp black. the viridescence
is blue & ultra violet.

Palladium becomes incandescent and I
think melts at about the same temperature
as platina, it become greatly
annealed, do not see any viridescence

notice that heavi pounds on strip have melted,
with the 0.0132. which weighed 0.0129.
by 2 hours more heat it loses 0.0004
(12) goes to 0.0125. we put on a fresh
battery but this did not make it move
incandescent as we used 1 cell less
unfortunately on pulling it in stand
again it fused. under the microscope
the sharp edges of the cracks are rounded
they have not materially increased
the core is as bright as ever. The
end is a beautiful ½ globule very
smooth.  thus

Notice what appears to be an air bubble

thus.

I noticed on taking away from the stand that under the microscope a large piece of some salt, or organic matter was attached to it. This might have caused the fusion by reducing the temperature at that point.

I again put the platinum to measure for 15 minutes, under the microscope the whole surface is crystalline, shewing the crystals perfect these are fine crystals & look like Antimony. They do not

Indices like the Iridium in the Pt-Ir
alloy = Between the crystals something
has apparently been eaten away as
the top + bottom of crystals require
a different focus of the microscope.
These crystals can be seen with the
naked eye, = crystals may be known as
= prisms =
I now having broken one small
0.0132 piece & substituted for the
battery the Gramme machine, and use
410 mm of Rayon's Pt wire, which I
have flattened out so as to be nearly
3/16ths wide, I brought it to incandescence
for 3 hours. Its first weight after

Cleaning by a momentary incandescence was. 0.3430. after 3 hours it weighs 0.3210

Gold cannot be brought (OOZ one) to red heat at least cannot see it in daylight (fuses) —

Ruthenium is probably the impurity in platina Gommer it quickly increases and becomes iridium. while platinum iridium does not appear to, Iridium (pure) Keeps bright, Rhodium becomes iridiscent but not near as

Muchas Ruthenium,

Upon putting Bichromate to ammonio-
it becomes covered with crystals
which shoot out from it like crystals
of permanganate Potash to the naked
Eye. they widen beautifully

Everything about Ruthenium looks
mounded & resembles fused Carbon.
I also notice these long needle
like crystals & I think they are
either osmium or Ruthenium.

oxygen has no other effect than to cool the wire like wind, It looks as if platinum was volatilized at a high temperature = The 410 mm wire after 1 more hour weighs 0.3103

When Pt-Ir wire has been in the Hydrogen flame for ½ an hour the green coloration disappears but by increasing the battery current passing through it. Itagain appears, of course the extra battery raised the temperature

The first cell having polarized

We put the 410 mm wire 1 hour more under incandescence it weighs 0.3075.

we incandesce it again for 1 hour and find that it weighs 0.3050.

we again put it to 1 hours incandesce after which it weighs 0.3018.

= note - I notice that Bichloride Platinum colors flame Ultra violet or greyish violet also green at the edge. This may be due to vapors of platinum -

We broke the 410 mm 1/2 weighs 0.1474, after 1 hours incandescence it weighs 0.1474.

I seal a piece of iron wire in glass
tube and I find that I can bring it to
a bright yellow color, when the tube
broke, I find that the oxidation skin is
very thin, owing the expansion of the iron in
the glass it touches and fuses the
latter.

Cut put the 1/2 of the old acid in and
bring to incandescence. It weighs cold
0.1541. It dissolved =

we now roll out a piece of 20 pc R4-3n alloy .020. and after bringing it to meandering we weigh and find weight to be 1.0147 we the put it to meandering with gramme machine. Then is about two hours about 1/16 wide - 10 o'clock & 20 minutes PM January 22 1879 -

I found three coins have been rolled Thinner in one piece, about 1/3 of it is brilliantly meandered while the remainder is yellow white - This piece busted last night at 7.20. after having been meandered for 6 hours. It weighs (1)60th grain

0.9188. Jany 23 1919
Under the microscope you
find that the cracks are still present
but within the cracks are innumerable
holes with a crater like appearance
The whole wire when examined results
the naked eye has the appearance
of frosted silver, one of the parts
of platinum wire weighed
after sterilizing at low red heat
appearance of it was bright. We weigh
and find that it weighs 0.3527.
time. 10 30 am. after being partially
incandescent at 3 o'clock PM it weighs
0.3325 grams. The end which was
incandescent the most is greatly
honeycombed, The proves that
platinum volitilizes at at yellow and
probably at a red heat and that
the green flame seen when held in
hydrogen flame is volalized Pt.

We now commence some experiments with the oxyhydrogen flame. to determine fusing points of non. conductors and metals. We make a rough guess as to fusibility by noticing the time and trouble it requires to fuse the substance

Platinum fuses quite readily- Rhodmium fuses easier than Platinum. Ruthinium does not fuse but something volatile comes off which colors the flame and the piece becomes light and porous.

Iridium does not fuse or color the flame or appear to get smaller. I will mention that the gases are not mixed before

consumption, the gases are burned from the orifices of two common blow pipes. Iron instantly melts and oxidizes but I think the extra heat due to its oxidation is the cause of its melting. Cobalt is very difficult to melt, it oxidizes slightly. Nickel is exceedingly difficult to melt and I think it has as high a melting point as platinum and possibly higher if fused in a vacuum and prevented from oxidizing - a globule of nickel in molten state was brilliantly incandescent and did not appear to oxidize or grow smaller. Silicium does not fuse but at a certain temperature it oxidizes with explosive

Boron does not fuse or apparently oxidize.
Aluminium becomes incandescent without oxidizing or melting but if the oxygen pipe be brought near it it instantly oxidizes –

Rutile is fused with exceeding difficulty it is a conductor both before and after fusion, after fusion a small piece thus. x.

has with powerful pressure a resistance of 62 ohms when powdered and a platinized block pressed upon the powder it had a resistance of 17 ohms

Metallic Zircon oxidizes at very high temperature. becomes coated on outside with white oxide -

Metallic Chromium from Johnson Mathey (Au) Co does not fuse that we can see, we get a current through it after fusing and by great pressure bring it down to 18 ohms

The chromium from Brooklyn given me by Beardsley is slightly attracted by the magnet showing iron - It fuses tolerably easy. The fused mass probably an oxides. Its resistance by great pressure is 20 ohms -

We now mould up a block of Titanic Acid for fusion in the O.H. flame, we find that it fuses at very high temperature, and the moulded piece contracts and cracks, owing to the volatilizin of the (something - = It does not conduct: It has in places a vitrous appearance Color azure -

Alloy Titanic Acid, Nickel = do not appear to mix -

Alloy Iron & Nickel. Iron burns up but think some has alloyed with the nickel, resistance of a button 1/2 ohm its Tō thick = ds very brittle

Molybdenum all goes off in fumes
Chromium & nickel do not alloy as we
cannot perfectly fuse the nickel
or touch the Chromium, I notice
Chromic colors on lime showing
oxidation.

We take a piece of nickel and roll it
out cut a narrow strip and pass
a current through it and very strange
to say it becomes brilliantly incandescent
with fusing. I think it nearly if not
equal to platinum - It slowly oxidizes
but we shall prevent this by sealing
the burner = when it does fuse it
acts like the Pt-Ir 20 pc alloy —
it remain hard when incandescent.

It is very probable that absolute chemically pure nickel will have a very much higer fusing point than the sample we have which is probably only commercial. This is a great discovery for electric Light — in the way of economy
Jany 24 1879.

Batchelor has succeeded in rolling nickel in sheets .002 thick. the piece was somewhat crack.

With another piece he has rolled it without a flaw or crack .003. and is now going to roll it thinner between steel plates; his success is due to annealing after each rolling -

a piece of 002 nickel is brought to yellow heat for 10 minutes on Gramme machine when it melts in a weak spot - a perfect globule is upon the end of the broken part - upon bending it gives a crackling sound shewing considerable oxidation - it is black & shining just like Russia Iron.

This oxide is extraordinarily tenacious the nickel may be bent several times nearly at right angle without shewing cracks in the oxide, but if bent 20 or 30 times exceedingly fine cracks may be detected under the microscope.

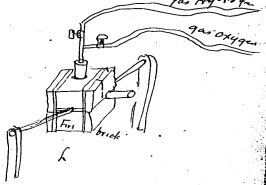
we have now rigged up a regular Oxy-Hy blowpipe like the lantern blowpipe. We melt in two minutes a pin head of Iridium (Ir M) - on flat lime - Ruthinium boils at once Something goes off leaving a porous something which is unfusable, Osmium Iridium - (Iridosmine) is infusible. but something comes off but not a great deal. nickel is not very easily fused it only fuses apparently when it oxidizes Chromium is a little harder to fuse than nickel - after fusing nickel it is quite malleable.

Osmium-Iridium after 1 hour with the O.H. flame does not fuse

January 27th

Last 3 days been arranging our apparatus for conducting experiments -

With O.H. Batchelor is now experimenting



Lime crucible inside -

I have rigged up two carbon points with the gramme machine and concentrate the arc in a lime crucible -

Melted Nickel and preserved it in bottle for future experiments - also alloy Ca + Ni also Ni + Fe also large quantity of Fe with small quantity Ni

Owing to the enormous power of the light my eyes commenced to pain after 7 hours work and I had to quit.

Jany 28 1879

Suffered the pains of hell with my eyes last night from 10 pm till 4 am when got to sleep with

365
1095

1 Machine. 1 ohm internal 1 external

100 000 ft lbs per minute. 60 000 in 50 000

Cost of machine, $100.- cost of power,

3 cents per hour 30 per day per year 109.50 - amt 10.

for 50 000 ft lbs $120.

4 machines, 4 ohms. 32 external -

100 lbs. 2 wire 84 000 outside. -

100.50 - for 84.000. interest 40 - make

$150 for 84,000.

$120 - for 50.000 2.40 per M.

150 " 84.000. Subterranean wire 78.000

Latter 1.92 per M.

a Big dose of Morphine, eyes getting better & do not pain much at 4 PM - but I lose 10 days =

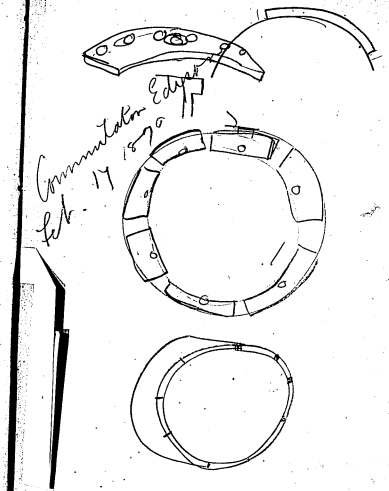
Zirconium - (metal ?) scales ~~in~~ good. Conductor

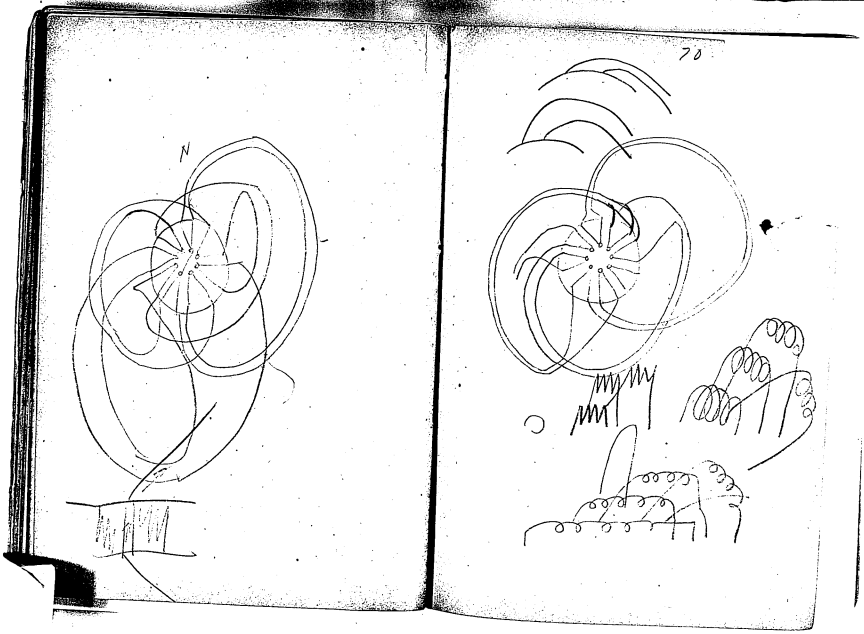
In fusing nickel the button is never apparantly covered with an oxide still there is a thick shell of something that is infusible covers the molten globule. yet when I take it out, it appears to be metallic nickel. There is something very curious about this matter.

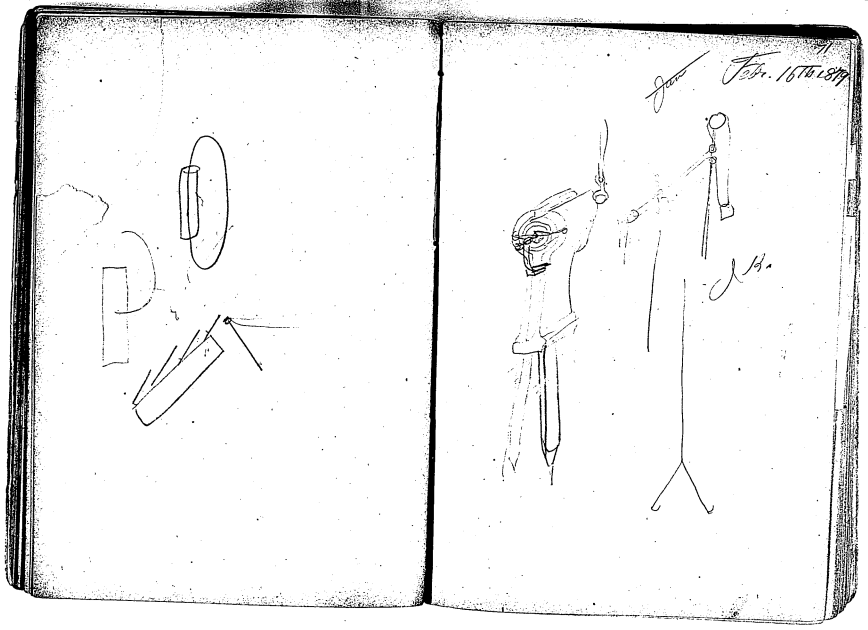
January 29. 1879

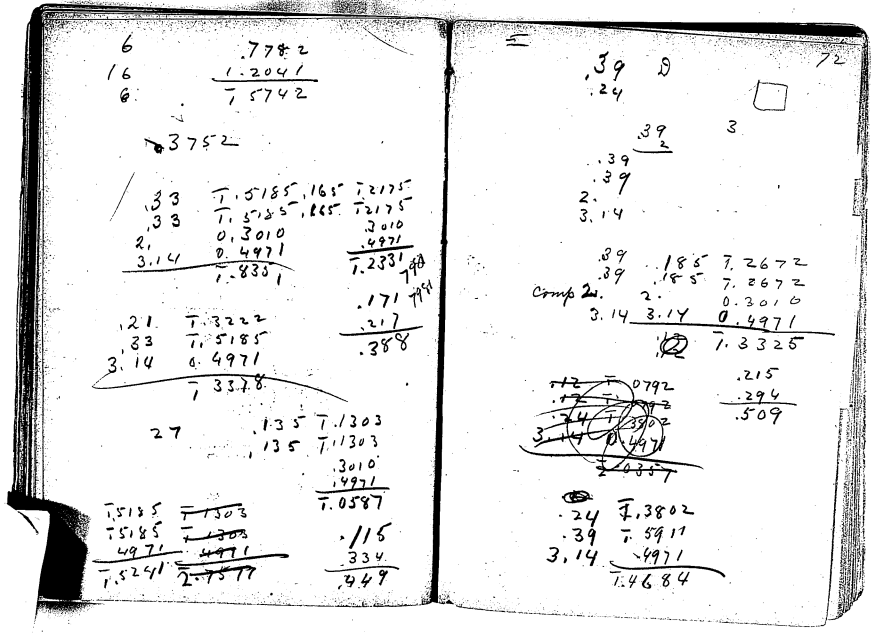
I am now grinding. Magnetic oxide of Iron to a fine powder for moulding in a stick =

oxide cobalt on OH. fuses and combines
with the lime and makes an infusible a
semi metallic compound. Grills but has
to break & a non-conductor = combined
with some magnetic Iron oxide doesn't
alter its properties -


Commutator Edge
Feb. 14, 1870.


N
70


Feb. 16th 1877
A.H.



30 .15 T. 1761
.15 T. 1761
2. 7981
3.1415
T. 1503

.30 T. 4771
.30 T. 4771
3.14 4971
T. 4513

,142

.285 .1425 T. 1538
.1425 T. 1538
7981
T. 1057

.1285 T. 4548 .127
.1285 T. 4548 .257
3.14 .4971 .384
T. 4107

February 22 1879.

Pages 73 to 91. "Use of Platinum & Iron Wires
Pyro-insulated, etc.
coils wound on Rims, with Platinum for the last"

Edison Laboratory Note Book # 22.

Pages 73 to 91.

See Edison Patents
237,237
237,238
213,238
214,236
214,237

Should be incandescent. I effect this by using an iron wire slightly larger than the platinum, made some tests with iron and platinum wire joined together + placed between

30 .15 1.1761
.15 .1761
2. .7981
3.1415

= .1507

.30 1.7711 .142
3.14 .4971

1.4107

February 22 1879.

Conceived the idea of using a coil of iron wire wound on Lime, with Platinum for the last layer. The iron and platinum to be pyro-insulated by acetate of magnesia. and the size and resistance of the iron made so that when it was at a bright yellow approaching white that the platinum should be incandescent. I effect this by using an iron wire slightly larger than the platinum.

Made some tests with iron and platinum wire joined together + placed between

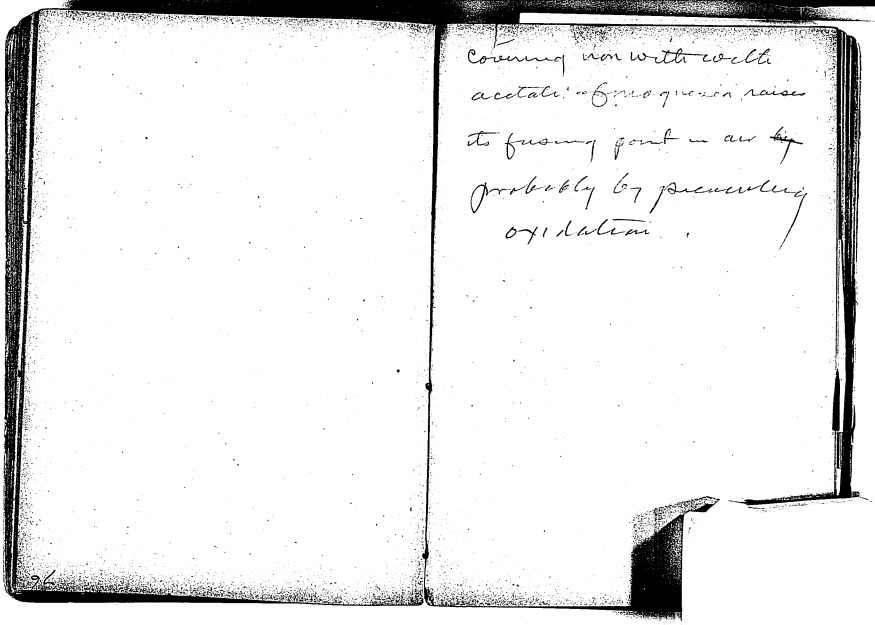
supported and heated with the Gallery [illegible]?

I find not the slightest difficulty in so selecting the size of the wires that the Pt. shall be brilliantly incandescent while the iron is yellow — Hence I can make a lamp with 1 inch of incandescent platinum (Pt) with a large resistance, the iron wire of iron serving all of its heat through the platinum, thus as a gain in economy of plant.

I noticed the jerk in the contraction and expansion of the iron wire when it reached certain temperatures. It is very noticeable and strong. Their expansion is different from the Contraction

If but a slight strain is put on
the wire when red it permanently
Elongates with ease, I think
Electricity passing through the
wire in conjunction with this
case of Elongation has something
to do with the [illegible]

I also noticed two Switches Expansions
while the wire was cooling I
very striking when it reached a
dull red the action after the al
was insisted, These jerks are
sometimes so sudden that
the wire is set vibrating


Covering iron with cobalt
acetate & finely powdered raises
its fusing point in air by
probably by preventing
oxidation.

Feb 22 1879

Feb 22 1879

Experiments for Evening Mies

Battery 13 cells Grove Harmon

Iron Platina 20/ Zinc .01

With Solution Acetate of Magnesia and the wire made incandescent and frequently dipped in solution. ½ inch in length when dipped in solution does not become red

even ¼ inch in length does not become red

With an Iron wire .01 it does not give visible signs of heat.

over

There is no signs of any deposit of Magnesia on these wires after dipping —

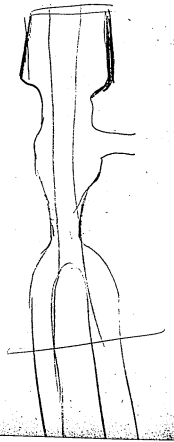
·014 Iron wire
·010 Platinum Iridium 2/0

Platinum becomes bright yellow and the iron bdrely visible red. I now increase the battery keeping equal lengths of the metals in circuit
Pt becomes yellow white &
Fe becomes dull yellow.
I now increase strength of battery again
Pt becomes pale white with tinge of yellow
Fe becomes yellow —

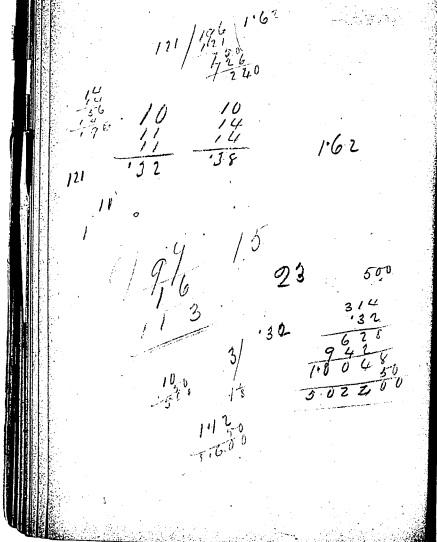
With
Pt/Pt. ·010 2/60
Fe ·016
equal lengths.
After the oxide has become
melted and run in globules
along the iron, it becomes
more infusible, probably because
this ~~oxide~~ prevents further
oxidisation, then the iron
ganged after scraping off
the oxide ·014
Platinum Brilliant white
Iron Yellow (dull)

With
Irridio Pt. 20% .010
Iron .011
equal lengths the iron
was brighter than the
Platina and melted when
the platina was only Yellow
This guaged after taking
out the oxide scraped off.
9¾ thousandths

With Irridio Pt 20% .010
Iron wire .012
Iron has most resistance



With equal lengths
Indio Platinum 20% .010
Iron .014
Iron melted by oxidising
undoubtedly in a vacuum
this would be all right
There is the difference between
~~Platinum~~ Brilliant White and
Yellow



~~Glass~~ Taking .011 wire (iron)
1 inch long spiral wound close
and afterwards pulled out
measures 28 inches
Taking .014 wire it measures 24

Spool made of .014 in layers
measures 15 10½ inches
Spool made of .011 inch
measures 26 - 9

---

600 m m of .011 iron wire
measures .97 ohms
600 m m of .014 iron wire
— .67 ohms 67
600 m.m. of Flat Iridio .010 20%
3.93 ohms

97 ohms = 281

97
17.3

56 metres Platinum resist

24 mil = 3'93
3'93
6 5

12/1.12 3.00 8.84
9

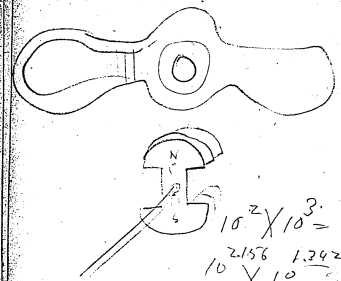
9

11 1/2 1/2
15 9 2
5 3
14.45

113
3
116
2 2
8 1 2
2 3 2
33 1 3 2

2
8
9
1 2
1 2
8 5

3/3.9
1.96
7.84



$10^2 \times 10^3 = 10^5$

$10^{2.158} \times 10^{1.242}$

250

$10^{2.3979}$

10^2 100

10^3 1000

1

84

4 | 250.000
625

250
250

250

2.3979
2.3979
4.7958

6.2770 .7958

.625

.62490

722	2.85585
638	2.8014
249.	2.3962
3.1415	0.4935
	8.1549 6

3544 0000.

Determination of the increase of resistance under heat of iron wires

600 mm of .011 iron

9 cells Heated dull red diffce 7° 4.97 ohms

9 cells " Red — 5.97

" about 4 inches was not as red as the rest

13 cells still red 6.6

15
100
900

165

.24 | 11

24 | 2.64
2 4
2 4
2 4

86

'011 Iron wire
300 m m Resist
6 cells dull red
7 Cells red
8 cells Bright red 3.9
Resistance 3.9 ohms
9 cells Full red
10 Cells yellowish red
Resistance 4.6 ohms
on again
10 cells
11 cells Reddish yellow 5.00
12 cells Yellow with hint of red 5.00
13 cells Yellow — 5.8 ohms

150 m m .011 Iron wire 87

3 cells

6 cells Yellow

7 cells Bright Yellow

2.64 ohms

$\frac{1}{50}$

20 | 60 | 66 | 1000 | 166 | $\frac{3}{150}$ | 16.6

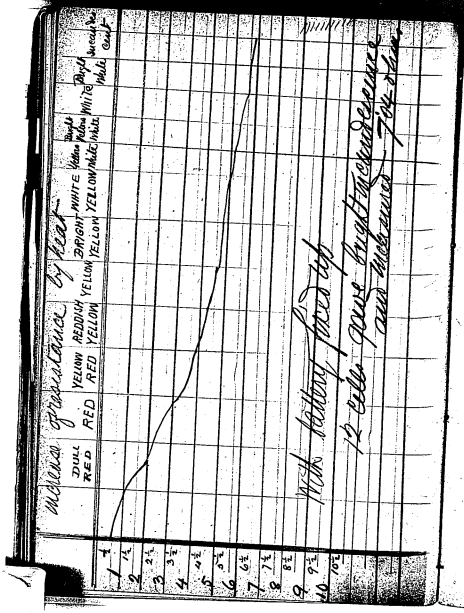
166

1660

1980

16.6

18 | 199.8 | 18 | 1 | 3



Iron wire Feb 22 1894 Charles Clarke

A Spiral coil of .011 iron wire 3/4 inch long and measuring when drawn out 12 inches has ~~with~~ a resistance of .5 ohms

Now we put in a Vacuum

2 cells	Dull Red	2.2 ohms
3 cells	Red	3.16 ohms
4 cells	Yellowish Red	3.8 ohms
5 cells	Reddish Yellow	4.3 ohms
6 cells	Yellow	4.5.7 ohms
7 cells	Bright Yellow	4.77 ohms
8 cells	Whitish Yellow	5 ohms
9 cells	Yellowish White	5.06
10 cells	Yellowish White	5.23
11 cells	White	5.5
12 cells	Bright White	5.6
13 cells	incandescent	6.4

Iron wire .011 Spiral wound
with 6 inches of wire in Vacuo

6 cells makes White 2.77 ohms
Busted at the next cell
Clear bright white

Thus increasing its resistance
a little over 11 times

Feb 23 1879
Chas Batchelor

9/2.77/8

11

5.5Ω

.41 475
71.4

475. 2.6767
.141 1.6128
Comp 71.4 8.1463 -10
10.4358
.4358

.273

5.7 85.9
71.4

1.5551
0.7559
8.1463 -10
10.4573

2.87

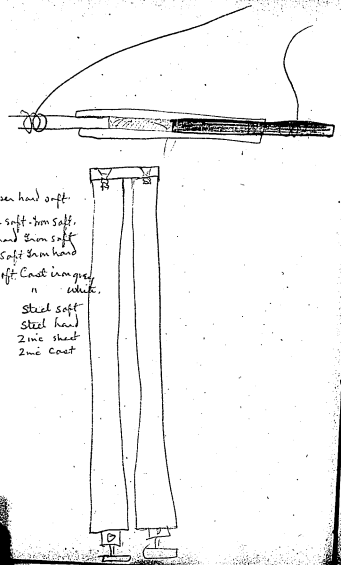
11.4 1.0569
19.4 1.2878
71.4 8.1463 - 10
.4910

3.01
2.73
2.87
3 | 8.61
287

Iron wire .011 6 inch long
wound in spiral and covered
while hot with Acetate of Mag-
nesia, in vacuum
Melted with 9 cells at a brilliant
incandescence and before melting
it measured 4.07 ohms
Thus increasing from ordinary
temperature a little over 19 times
its ordinary resistance

Feb 23 1919
Chas Batchelder

20



Iron wire .015. 12 inch long
wound in spiral on ⅛ mandril
covered with Acetate Magnesia
and put in Vacuo.
Resistance when cold .24 ohms.
With 12 cells it gave about
3 candles and melted a
brilliant hole.

Feb 29 1879

Chas Batchelor

1 Weber = current that
1 Volt will send through 1 Ohm

12
6 Ohms
6 Ohm
12

24 = E

C = 24/12 = 2

12 Ohms
2 Weber
24 Units

$C^2 R t$

$2E$

10^{-1} 10^{+8} =

10^7 Work

1 Weber Work

10 000 000
10 000 000
10 000 000
10 000 000
10 000 000
10 000 000

Gramme Centimeter

10,000,000

10000 000

10000000

10,000,0000

10^{-1}

$\frac{1}{10} \times \frac{1}{10} = \frac{1}{10^2}$ $10^9 = 10^7$

10,000,000

~~10000000~~ $\frac{g^2 m}{T^2}$ Kilo

100

~~1000~~ 10 Kilo Metres

1000

24000

43

100

$\frac{3}{2}$

1000

1000 Gm. Mt. 43380

1 Gm. Mt. 4 (433.80.

10,845

1 Gm. Mt. 6

.002205

3.281

.0072339

7.2339

7.25

~~4.60~~

433.80

A m absolute unit Gm. M. S.
is equal to how many Gm. M.

$\frac{1}{9.81}$ Gm Cm S

A Dyne is equal to the
Wt of $\frac{1}{981}$ Grammes at Paris

Gm Cm S $\frac{1}{981}$ Gm Cm

$\frac{1}{981}$ $\frac{1}{981}$ $\frac{1}{981}$ $\frac{1}{981}$

$\frac{L^2 m}{T^2}$ $\frac{1}{981}$

$\frac{10000}{981}$ $\frac{100}{981}$

.00 10195

100. 2
981. 2.991669
T. 0 08331

.1019 42

Gm Cm S = Dyne

$\frac{1}{981}$ Gm Cm = Eng

33000 ft. lbs. 33000 Eng
33.000
33.000

$\frac{L^2 M}{T^2}$

$\frac{L^2 m}{T^2}$ = Gy

$\frac{F}{} = \frac{m v}{t}$ $\frac{Lm}{T^2}$

33000

33000 ft. lbs

39000

$$lb = \left(\frac{l^2 m}{T^2}\right)$$

$$ft = \frac{}{l}$$

Kilo $\frac{16 ft}{981}$ cent

$ft = 16$ ft

33000 ft lbs

$$ft = \frac{1}{3.280839} \text{ Meters}$$

lb

Gramme metre = .

3.859372 4)4200

12.140628 1050

2.140628

138.2 $\frac{3}{500}$

log 33000 4.518514

1.140628

3.659142

456.2 Kilo Meter = H.P.

456,200 Kil. Cm.

456,200,000 Gr. Gm Cm.

456,200,000 X 981 = Gr. Gm S

= Ergs

A = 63°

D = 63°

55° 30'

R = .4 .5

1.96

1.45

.51

.5 .5 / 1.45 1.50 .5 / .03 5/3

1.5

.5 5/14 2.5/14

14) 2.5 (.17
14
110
98
12
.18

.41 X .51

1.45

41
205
1.45) 20.91 (.14
145
1641
680
1.14 Ohm

87° 30' 4.51

70° 30' 2.82

.6 Ohm

4.51
2.82
1.69

2.82 | 8.45 | 3
846

..1.5 Ohms

30
2 | 22
.11 Ohm

12² 12 / 121 / 132

12 / 132 12 / 1.32 24 / 1-32

1.

24
42
48
196
2008) 33000 (15

24 / 2 12 / 12 / 144

Bright red 14 Ohms

300 mm 10% Rt Jr .005in

600 mm cold

17.5 9 ques

8.7

200 mm 10% .005"

10 Ohms

Bright yellow

150 mm White 8.7 Ohms

Cold 4.2+

4 | 17.5

4.37

125 mm Very white .98

Hot 8 Ohms; Cold 3.4 Ohm

100 mm Melted

Lamps cold ~~3.6~~ Ohms

3.6

.60

Say Camp. 1 Ohm Unit

~~1.5 Ohms~~

15 internal

2.5 ~~Ohms~~ External

$\frac{24}{2.5} = 10.$ Webers

~~25~~

42 ft lbs Weber Ohm minute

420 ft lbs

420) 3300 (78

294

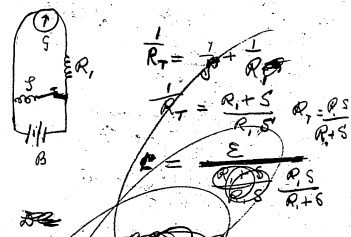
360

$C^2 R$

99

D = Deflection

$$D = \frac{\mathcal{E}}{G + R + B}$$



$$\frac{1}{R_T} = \frac{1}{S} + \frac{1}{R_1 + G}$$

$$\frac{1}{R_T} = \frac{R_1 + G + S}{S(R_1 + G)} \qquad R_T = \frac{S(R_1 + G)}{R_1 + G + S}$$

$$\mathcal{E} = \frac{\mathcal{E}}{\frac{S(R_1+G)}{R_1+G+S} + B}$$

$$\frac{R_T S}{R_T + S}$$

$$D : C :: \frac{R_T \mathcal{E}}{R_T + S} : R_1$$

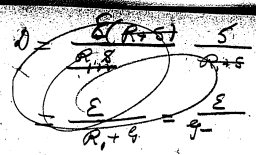
$$D = \frac{\mathcal{E}}{R_T + S} C$$

$$D = \frac{\frac{\mathcal{E}(R_1+G)}{R_1+G+S}}{\frac{S(R_1+G)}{R_1+G+S} + B} \cdot \frac{S}{R_1+G} = \frac{\mathcal{E} S}{S(R_1+G) + B(R_1+G+S)} = \frac{\mathcal{E}}{G + R + B}$$

$$S(B + R + G) = S(R_1 + G) + B(R_1 + G + S)$$

$$SR - SR_1 = B(R_1 + G)$$

$$B = S\frac{R - R_1}{R_1 + G} \quad \text{Ans.}$$



100

$$D = \frac{\mathcal{E}}{g + R + B}$$

$$D_1 = \frac{\mathcal{E}\, S}{S(R+g) + B(R_0 + g + S)}$$

$$S D (g + R + B) = D_1 (S(R+g) + B(R + g + S))$$

$$S D = D_1 S + D_1 B + D_1 \frac{B S}{R+g}$$

$$B = \frac{D_1 S}{S D - D_1 - \frac{D_1 S}{R+g}}$$

$$S \frac{D_1}{S D - D_1 - \frac{D_1 S}{g}} \qquad R = 0$$

$$S \frac{D_1}{S}$$

$$\frac{D_1}{S D - D_1 \frac{g+S}{g}}$$

$$D = \frac{\mathcal{E}}{g + B}$$

$$D_1 = \frac{\mathcal{E}\, S}{S g + B(g+S)}$$

$$D(g + B) = D_1 S g + D_1 B (g + S)$$

$$D B - D_1 B (g + S) = D_1 S g - D S g$$

$$= (D_1 - D) S g$$

$$B = \frac{(D_1 - D) S g}{D S - D_1 (g + S)}$$

$$= S \frac{(D_1 - D) g}{D S - D_1 (g + S)}$$

$$\frac{(D - D_1) g}{D_1 (g + S) - D S}$$

$$B = \frac{D - D_1}{D_1 - (D_0 - D)\frac{S}{g}} = \frac{D - D_1}{D_1 \frac{g+S}{g} - D \frac{S}{g}}$$

$1^{0}30'$

60° 30

52°

.2 ohm

1.76
1.27
.49

.49
1.27

.49
.2
1.27) .98 (.0
.098

49
.2

1.27) 0980 (.08 49

470 1.07

.1

2.70 .50

1.07
.50
.57

.50) 57 (.11
50
70

.11 ohm

Condit Hanscome Old

Used a thick wire .1 Ohm for resistance under formula

$$B = S\,\frac{D - D_1}{D_1}$$

N = 49° 30'

31°

60 / 0.57

.096 Ohm

1.17
.60
.57 another cell

.60 / 1.04
.08 Ohm

No 3 cell

58°

35°

1.60
.70
.90

.70 / .90
.13 Ohm

50°

1.19

280

53
66

53 / 066 (.12
53
130

.11
.12
.13
.09
4 / .45
.11

New cell

Chromate new

50°

26°

1.19
.48
71

48) 071 (.15
48
230
240

Meter outside

45°

21 30

.16 Ohm

1.00
.39
61

39) 061 (.15
39
220
195

Battery old 13 cells

11
13
33
143 Ohms

Fresh .15
13
45
15
1.95 Ohms

3) 26
8.66

$\frac{26}{3}$ = Weber

$\mathcal{E}$ = 26 Volts

R = 3 ohms

8.66
8.66

0.937518
1875036

3316) 33000 (10
3316

7.5.

.737
60
44.220
75.
22110
30954
331650

10 lamps per H.P.

Metre = 3.281

7.2331 ft lb. = 1 kilo Metre

log = 0.8593
.13825 kilo Metre = 1 ft lb
log = 9.1407 − 10.
Erg = .00102 Gr. Centi.

Erg =
1 Gr. Centi. Sec. = 1/981 Gr. centi = log

log .00102
Log Erg = 7.009 − 10

1 Kilo Metre = 1000 X 100. Gramme Centi
= 10^5 100000
= 10^5

1 Weber = 10^{-1}
1 Ohm = 10^9 1/10

$(10^{-1})^2 \times 10^9 = 10^7$

log 10^7 7.

Comp log .13825 .8593
comp log 10^5 5 −10
log .00102 7.009 −10
1.8683

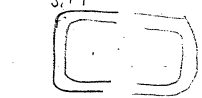
.738
60
44.280 ft lbs Weber over one Ohm

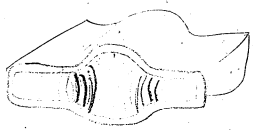
105

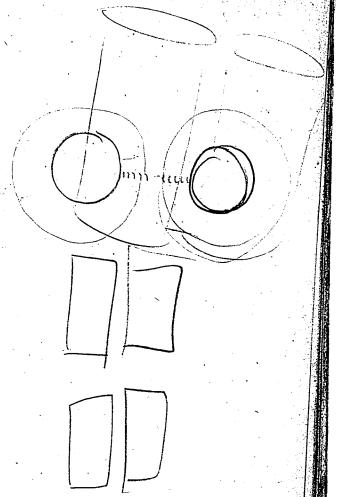
1.21 0.0828
1.82 0.2601
1.16 0.0414
.3843

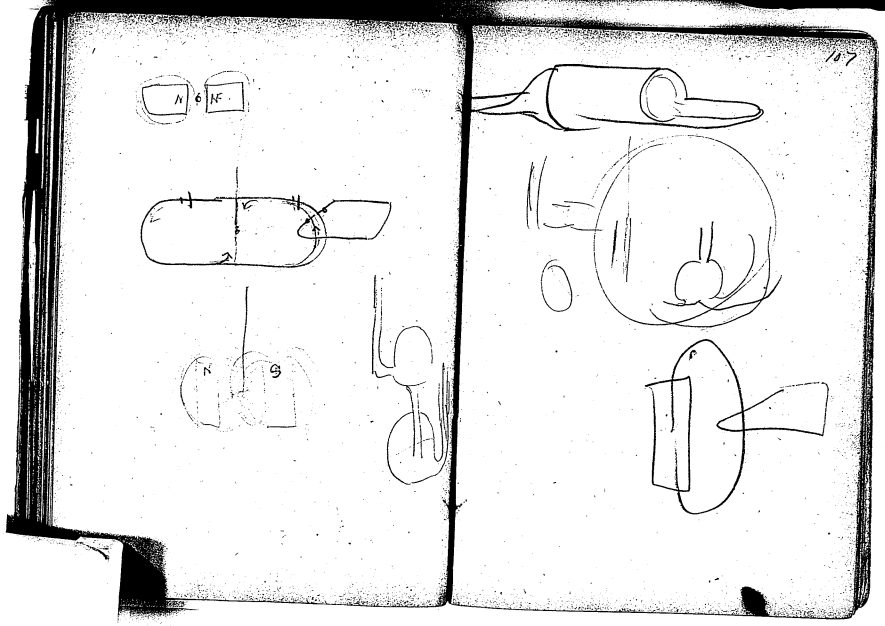
2.4

3.14





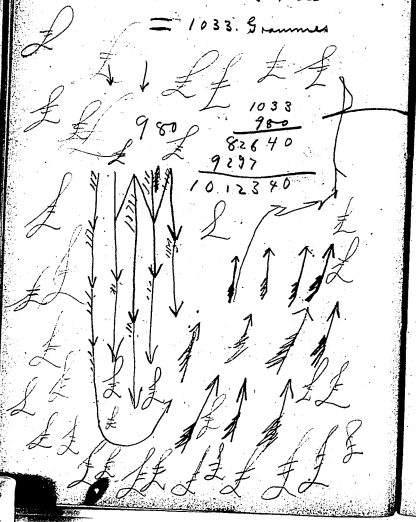



N
S
N
S

1
9 8 1

1,033 Kilo
= 1033. Grammes

1033
980
82640
9297
10.12340



1,32

33000 1 Ohm

1 Ohm C = 1 Ohm
1 Volt
1 Ohm 1 Ohm
1 Ohm 1 Ohm Ohm
1 Ohm
1 Ohm 1 Ohm
1 Ohm 1 Ohm 1 Ohm
1 Ohm 1 Ohm

772

1 foot

772 foot lbs.

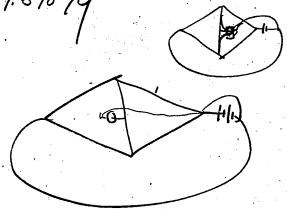
1 foot lbs =

1 lb -

1 foot = 3 1 3 9.3 0 [illegible]

1 3 . 1 2 3 5 [illegible]

= 12 / 39.37079 metre



$C = \frac{Q}{R}$

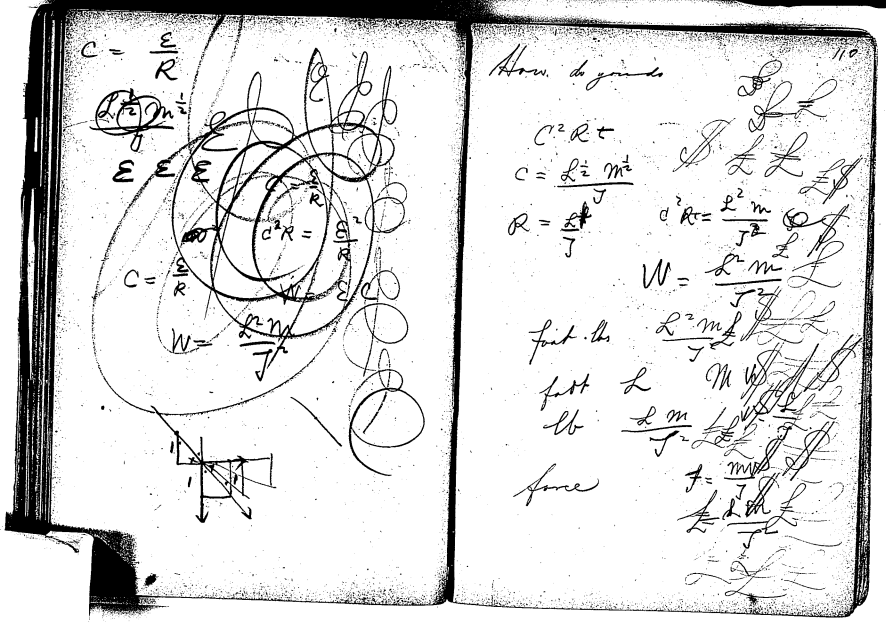
$C = \frac{L^{\frac{1}{2}} m^{\frac{1}{2}}}{T^{\Theta}}$ $\quad R = \frac{L}{T}$

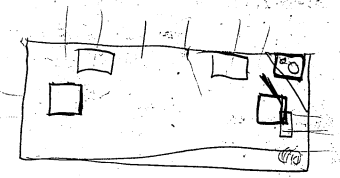
$C^2 R = \frac{L^2 m}{T^3}$

$\frac{L^{\frac{3}{2}} m^{\frac{1}{2}}}{T^2}$ $\quad \frac{L^3 m}{T^4}$ $\quad \frac{T}{L}$

$\frac{L^2 m}{T^3}$

109


C = ε/R
ε ε ε
C²R =
C = ε/k
W =
Hom. de grandeur
C²R t
C = L^½ m^½ / T
R = ε t / T
C²Rt = L² m / T²
W = L² m / T²
joint. lb
L² m / T²
joint L
lb L m / T²
force
f = m L / T²



500 Ohm lamps

Weber² Resistance

3300 for 15 candles

$C^2R = 3300$

$C^2 = \frac{3300}{500} = 6.6$

$\frac{26}{3} = 8.66$ Webers

8.66 Webers in 10 ohm lamps to bring it to 500 — descence

$(8.66)^2 = 75$

75 Watts given off by 8.66 Webers in 10 ohms

How many Webers will be required to give off the same on 500 ohms

$\frac{75}{500} = .15$

$\sqrt{.15}$ — 1.1761 — 1.5880

$.387 = \frac{x}{500}$

$\frac{.387}{193500}$ $\frac{500}{}$

866) 193.500 (22
1732
2030
1732
0

193 Volts

26) 193 (7.4
182
110

9900) 33000 (3 3
297
330
297

3.3 3 Batteries to 13 cells C.H.H gave out in all 1 HP of on a circuit with 1 Ohm outside. E = 2.6 R = 3 Ohm
26 Volts

9900 ft lbs of energy given off every minute

1 lb of Zn has

33 grms Zn gave off — burning in H. 50 4 18682 Grm C°

Log 18,682. 4 261377
Log 42 4. Gm Metres 1. 627366
Log Kilo M. 7.233 0.859318
Comp Hong 33. 8 481486 -10
Grm Cent = 424 Kilo M 6.229547 -10
3
3

1698. ft lbs for grm

English

5 | 3 2 5 | 150 9/5 5/9
7 6 5

1.772 English
5/9
9 | 3466 Nly
427 Remainder lbs

42 @ Gm Meter = 1 gm H_2O 1°C

How many ft. lbs. = 1 lb 1°F

log 42.4

log $\frac{9}{5}$ = 1.8

log

9900 / 594,000) 1,848,195.

log 1.848 6.266747

amp log 5-94,000 4.226214 -10

.492961

3.11 hours to burn one lb of Zn in 13 cells on one Ohm outside these being no polarization and the whole equiv. used of the Zn. No local action.

772
9
6948

$\frac{9}{5} \times \frac{1}{3.28}$

5
16.40

16.4) 6948 (424
656
388
328
600

772 ft lbs - 1 lb 1° F

772 $\frac{9}{5} \times \frac{1}{3.28}$ gr Mets 1 gr 1°C

= 424

What does 1/2 in. Cu wire weigh 1/4 per foot and cost

1/2 Sp. G. Cu = 8.9

18 cts per lb.

$A = \pi R^2$

3.1415
884

$R = \frac{1}{4}$

$R^2 = \frac{1}{16}$

Area section	log	3.1415	0.4970686
Area sq log		16	8 7979590 -10
length	log	12	1. 0791.81
sp Gr	log	8.9	9. 949390
cost	log	18	1. 2552,73
grains in sq in footer		252.4	2. 402089
grains Cu in ft	log	7000	6. 8548902-10
Cost foot		1.5	1.
Cost Cu in			
Cu in in ft of wire			12

Log 1323.5 3.121560
Comp Log 7000 6.154902 - 10
Log 18 1.255273
Log 4 .602060
1.133795

@ 13.8 cts per ft

.189
4
.756

7000 | 1323.
@189
4
@.756

189
1000
.756
18
6048
756
13.608

252.5 2.402261
comp 64 8.193820 - 10 1/4
3.1415 0.497068
12 1.079181 1/2
2.172330
8.9 0.949390
3.121720 1/4

1324. Grains in ft

13.8 cts per ft

4 | 1654
.0413 Ohms in 1000 ft 1/2 in
528
3304
826
2065
.21806 Ohms in mile
25
1090
436
.15450 Ohm in 2 1/2 miles

115

6 | .5450 .0908

6 strands ½ in 6 thru 2½ mile

.0605 | 500.0000 | 8223.
4864
1360
1216
1440
1216
2240

1 : 8223
1 : 8000

15 | 500 | 33
45
55

1000
6608

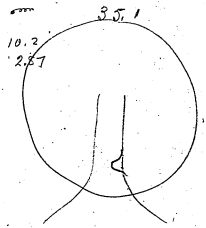
.0608
.0908

.0908
10
.9080 in Machine Str. 1
Say

$200 a year interest 10
each lamp burn 3 hours a day
say 1000 hours a year
30000 hours in all

3000 | 2000 cts
.666+ cts

$.00666 an hour for interest
at a distance of 2½ miles



Steague on E. M. F.

Calory = 423.55 Gramme Metre

a calory is the amt. of heat required to bring 1 Gram of H_2O from 4°C to 5°C

1 Gramme of H gives out 1330. Calories in burning

H 6800 ft. lbs. per gram equiv.

~~47,600,000~~ 7000 ft. lbs. in lb.

6 | 47,600,000
7,950,000

4 | 47,600,000.00
11,900,000

10
32.6 | 47.600,000 (1,460,000
32.6
1500
1304
1960

117

A current that uses 32.6 grains of Zn in battery will carry 108 grains of Ag in Voltameter or 1 grain of H free or 8 grains of O

That is any current will

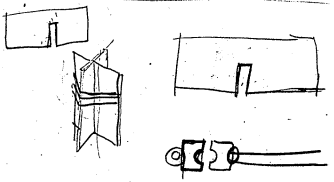
1,000 103

108 | 01.116 (0001
0108

00552
2
01104

0106 00186
2

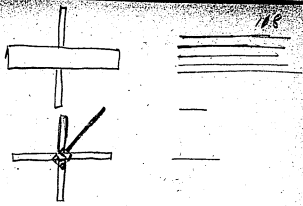
C.S.S
.0092



8
4 inch

? ft

4 inches wide
12 high
notches 1/8 inch apart



1/2 inch

1/8 in wire

425 Gramme Metre

42500 Grand Centimetre

42500 — 4.628389
981 — 2.991669
7.620058

Calorie = 41.700.000 Absolute measure
Gm. Cent. S.

$qq = Qq\,\theta_2$
$q = J\,\theta E$
$qq = qq\,\theta_2$

	Jenkin	Emy. Brit.
$E =$ Zn	.00342	.00336
Cu	.00324	.00326

324 — 2.510545 — 119
342 — 2.534026
1.976519

.954
326 — 2.513218
336 — 2.526379
1986879

910

788.4 = Thermal equiv 1 Gramme Zn in Daniells cell

Smee
33 | 18682 (566
165
218
198
202
198

Daniells
65 | 47470 (736
453
237
195
420

34.462 Grammes of H_2O raised from 4°C to 5°C by the combustion of 1 Grammme of H.

1 Gramme H_2O raised from 4°C to 5°C is equal to 4235.55 G.C. = 1 Calory
423.55 G.M.

1 lb. = 453.59 Grammes

34.462 .198547 6000 = 51.320000

4.567320 .297798 4.845094 = 8.710216

34.462 lbs. H_2O from 4°C to 5°C
1 lb. H

34.462 × 9/5 = .18

34.462 4.567320

1.8 0.255273 Right

77 2887617

3.28 5.157174 Metric do not come into this calculation

H_2 8.226084

.51 0546 Wrong

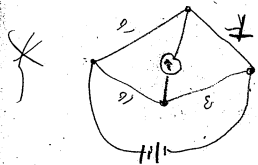
7.71538

~~51.470000. If the Wrong~~

~~47.890.000 gr. ft lbs.~~ See p. before

~~Raise from~~ 5 ft Take 5/9 of the energy to raise 1 lb of H_2O from 37°F to 38°F than it does the same from 4°C to 5°C

9/5 more lbs. can be raised from 37°F to 38°F than from 4°C to 5°C by the same amt. of heat.

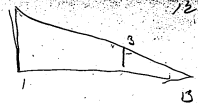


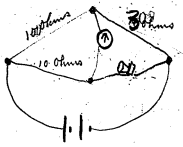
Lamps	hours	out in a month
100.	10	
200	20	1
300	30	2
400	40	3
500	50	4
600	60.	5
		6

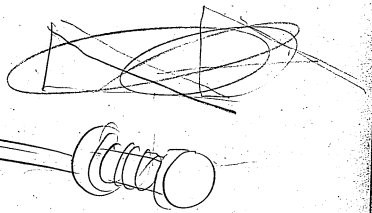
100 (3000

3000 lamps per month

100 lamps a day







7.0082849
2.6269.47
4.5813802

7.0082849
3.8593
4.8675

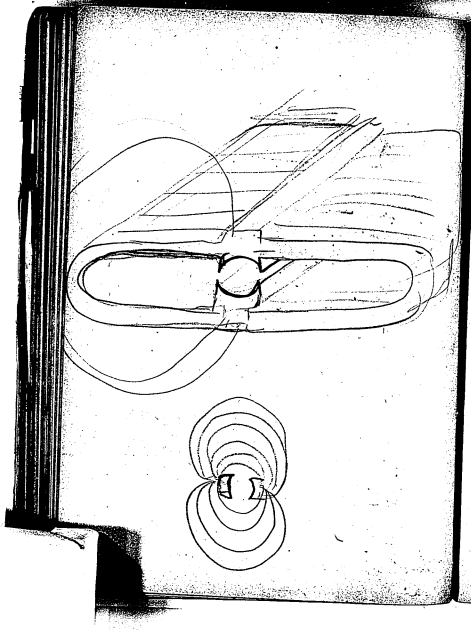
Calonices per gramme means the no. of calonies a gramme of any substance will give in burning.

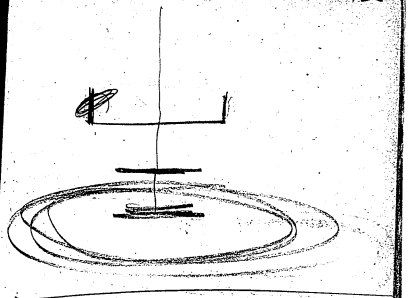
1.1884
2.6269
3.8593
1.6746
2.3768
7.2978

To change Calonies per gramme to calonies per gram divide by 1/15.434

2 ohm
13
26
4.2
13
90 ft
13
13
0

1.3813859





.10192 1.008284
1000. 3.
.007239 3.859372
60 1.778151
1.645807

44.24

ft lbs per unit of current through a ohm work done in a minute

1 Weber of current will decompose .00093 Grammes of H_2O in one second or .000103 Grammes of H will be given off at the pole. That is one Faraid passing through a H_2O will decompose this amt.

.00093 Grammes equals how many grains

log .00093 $\overline{4}.968683$
log 15.4 1.188478
$\overline{3}.156961$

.01435 Grains of H_2O in one second

This is what Straquis calls a Chemin No

in a 10 hours

36000

A chemin is the amount of current wh. is required to free 1 grain of H in ten hours.

A chemin is a current of such strength that it will decompose 1 grain of H in ten hours. So he say but his table makes it only one hour

.0142 .00142

14.	1.42	1.42
	36	36
	852	51.12
	426	
	51.12	

Brit. Encyc. p. 105

says that a Weber is see before

.00093 Grammes in one Grain

7000 Grains

1 Kilo = 2.205 lbs

$\frac{1}{2.205}$ Kilo = 1 lb

= 7000 grains

$\frac{1000}{2.205}$ Grammes = 7000 grains

$\frac{1}{2.205}$ Gramme = 7 grains

2.205) 7000 (3

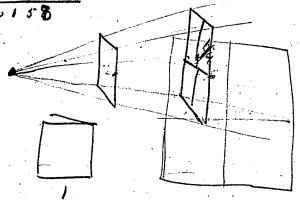
1 Gramme = 15435 Grains

.00093
15
465
93
.01395

93

20 + 5 = 25 −

9/0142 −5
.00158



1 Weber through 1 ohm

44.24 ft lbs in minute

log 1.645807

~~Calg 60~~

1 Weber through 1 ohm

give 100,000 C.G.S. units of work

~~Calg 100000~~	5
log .0010192	$\bar{3}.008284$
antilog 428.55	~~2626855~~
	7.373145
	.381429

.2406

.2406 Calories for 1 Weber during one seconds.

1 Weber in one hour will decompose 5.68 grains of H

I don't know what he means

Prague p 216 shows that the equiv. of 1 grain of H will give 4673 ft lbs of energy

4673 × 7000

32,731,000 ft lbs in lb of H !

.000163	$\bar{4}.012837$
15.435	1.188566
	$\bar{3}.201203$

log .001586 log $\bar{1}$ = 0

2.798797

629.2 Seconds for one Weber current to ~~decompose~~ put 1 grain of H from H_2O

1.37
37

.00158 3 20.203
3600 3.

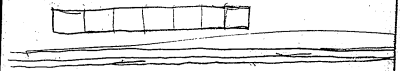
1 Web of current will set free .000103 Grammes of H in one second.

The electromotive force depends on the energy given off by atomic equivalents ~~of~~ ~~bread extract~~ when all the energy of combustion is changed to electricity.

.000103 Gramme
.00103 Dekagramme
.0103 Centigrammes
.103 Milligramme

200 ft. lbs. 127

6. 5.00
45
12.
12
144



65 | 47.70 (733
35 5
27
195
220

733 Heat units for Grammes of Zn. in Daniells Rawalt

1 Weber of current requires .03411 Grammes of Zn every second to be carried into solution. Brit. Cyc. P. 84

From deg C

733 - Heat units.

log	733	2.865104
log	42355.	4.626340
log	.03411	$\bar{1}$.532882 = 9.150891
log	9.81	0.991669 1.41550
		8.015995

Volts

1 Daniells = 1.037×10^8 ans

42355 Gm C = 1 Heat unit Brunel

1 Gm C = 9.81 C.G.S.

Berthenal gives 128

1 Gramme of H burning will heat 34.462 Grammes from 4° to 5°

it will form 9 Gramme of H_2O

ie 9)34462

3829 Heat units in one Grammes of H_2O

Zn	733	2.865104
	32.6	1.513216
		4.378222
comp		5.621678 −10
log	34.462	4.537318
		10.158996 −10
log	1.442	0.+

the electromotive force of H_2O in Volts Daniells when decomposed i.e the lowest E.M.F that will send a current through H_2O

How many lbs. of Zn will it require in a Smee battery to produce a H.P in heating of Whole circuit Ans Chap 6 p. 85.

Data 617 Thermal units Gm Degrees C from burning 1 unit of Zn

log 617	2.790285
log 141550	5.150891
	7.941176

.873 Volts = E.M.F.

1 Thermal unit Gm Degree C. = 141550 ft. lbs
log = 5.150891

9/5 = 1.8

9/5 617 Thermal Gm Degrees C = X Thermal Log

617	2.790285	
1.8	0.255273	2.142890
772	2.887617	
	5.933175	

857.350 ft. lbs.

log 857.350	5.933175	
comp log 33000	5.481486	− 10
	1.414661	

25.95 H.P. for one minute by the burning 1 lb of Zn. in a Smee battery.

How many lbs of Zn. to run 1 H. P. one hour?

log 60	1.778151	
comp log 25.95	8.585339	− 10
	.363490	

2.31 lbs of Zn to give a H.P. for one Hour from a Smee battery Zn. & Pt. in one fluid.

The same question for Daniell cell.

Data Brit Emg C. 85 805 Thomdike

log 805 2.905796
log 1.41 — 5.150891
8,056687

1.14 Volts

2.905796
3.142890
6.048686
4 0 3 2
6 0 4 8

4118,700. ft lbs from one lb. Zn burned in Daniell.

6.048686
5.481486 − 10
6 2 2 0
1.520172

33.1
55.1 ~~108~~

Consumption 1 lb per minute.

1.77815 − 1
8.479828 − 10

1.44 ~~2.44~~ lbs per hour per H.P.

19.257779

Carbon to chromate 130

1.9 Daniells

1.14
1.19
1026
114
2166 Volts

1.118.700
1.9

6.048686
0.278754
6.317440

2.078000 ft. lbs. per lb. Zn.

Nitric acid

(N) = 1,387. Heat units

1.297798 Calories per gramme
3.845098 = foot lbs per gramme X by
3.142896 to reduce calories to foot lbs

1,387. 3.142076
3.142896
6.284972

1,927000. ft. lbs. per lb. Zn

Favre & Silbermann give a Lime as equal to 566
i.e. 1 Gm. of Zn will heat 566 Gms. of H_2O from 4°C to 5°C

H	Thermal units
34,462.	4.537318
1.587	3.142890
772.5	
	7.680208

47,899,000 ft. lbs. by burning 1 lb. of H.

7.680208

Comp. log 32.6 8.486782 -10

6.166990

1,468,000 ft. lbs. from 1 lb of Zn. burned in O.

34462 lbs raised from

Sprague gives Zn burned in O

1 lb 1,845,000 ft. lbs.

Carbon 11,228,000 ft. lbs per lb

1 lbs per H.P. per hour

log	11228000	7.050310
comp. log	33.000	5.481486 -10
log	60	8.221848 -10
		.753644

$\frac{1}{5.6}$ of the theoretical

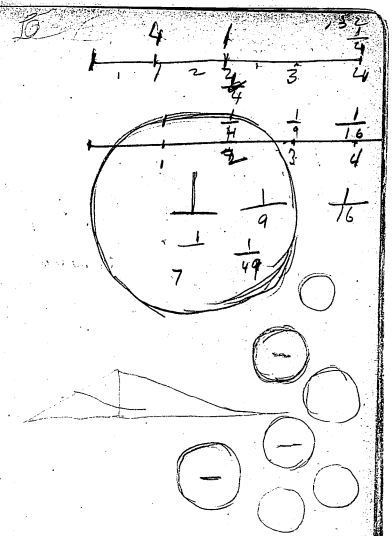
2 lbs	11.2	33000
3 lbs	16.8	60
4 lbs	22.4	1980,000
&c	&c	

1,845000 ft. lbs. per lb. gas burned in air

6.265796
6.857164 -10
3.128100

1328 calories Ethan
1330 " Sprague

7 min) 47,896,000.
6,833.



How many foot lbs in a megaerg = 1,000,000 Ergs

981 Ergs = Gramme centimetre

1 Gramme = ~~.0022046~~ lbs
.002204

1 Centimetre = .03281 ft.

log .002204 = $\bar{3}.343212$
log .03281 = $\bar{2}.516006$
Comp Log 981 = $7.008331-10$
8.709668

.000000 5524

.0000502

$\bar{3}.343212$
~~.0000~~
5.701337
$\bar{3}.343212$
$\bar{2}.516006$
$\bar{3}.859218$
$7.008331-10$
8.867549

.0000.7232

.0000000 7371

Megaerg Erg six
.07371 ft lbs

33000 Erg time = 7.371 ft lbs

Erg = Gm. Cent. S.

1 Unit of work = 10^7 Weber through Ohm
= .7.371 ft lbs in one second

$\frac{.7371}{60}$

44.2260 ft. lbs. in a minute given off by a Weber a second

A Weber per second through 1 Ohm gives off 10 Megaergs of energy in a second or 1 Erg seven

Eq 33 000 4 5185514
comply .07371 11.140782 -10
5.65929 6

456.2 Megalergs ~~in H. P~~
456.2 Erg nine

To raise 1 Mgr from the earth a force of 9806 $\frac{Mm \cdot Mgr}{Sec^2}$ is required

9806

1 Grammme
980.6 $\frac{Cm \cdot Gr}{Sec^2} = F$

lifting 1 Gr 1 Metre requires work
$9806 \times 10^6 \times \frac{Mm^2\ Mgr}{Sec^2}$

$9806 \times 10^2\ \frac{Mm^2\ Gr}{Sec^2}$

Kohlrausch gives the equiv 1 Gm H_2O 0°C to 1°C as 430 Gramme Metres

= 430 : 9806 · 10^6 · $\frac{Mm^2\ Mgr}{Sec^2}$

423.55 Shuttleworth
424 Pickering
430 Kohlrausch

2500
$ 7500 000

$R = R \frac{\Delta - \Delta_1}{\Delta_1}$ R = .55 Ohm
.15 Ohm

$\Delta = 35°$

$D = 36°$ B

$D_1 = .16°$

.15

2.54
28

.649
1286

363) 649 (20
626
230

.15

286) 363 (1
286
770

1.15
1.13
345
115
1.495 ohms

37° 45'
160

The method of measuring resistances is very faulty as the polarization of the battery gives a lo

2 cells

$S = \frac{D - D_1}{D_1}$

$D = 649$

$D_1 = 286$

$D - D_1 = 363$

Very acid

286)363 (1.26

286

770

572

1980

1430

1716

264

127

.15

635

127

2)19.05

.095 ohms

$37^\circ 45'$

16°

$\frac{D - D_1}{D_1}$

136

$D = 753$

$D_1 = 286$

467

286)467 (1.63

286

1810

1716

940

1.63

.5

815

163

2)2.445

122

Resistance of Conduit and Flow
.12.2
13
366
122
15.86

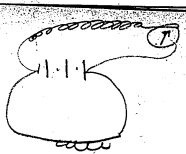
1.6 Ohms total
battery old

1.3 Ohms when new

2.3 | 26
10

10.
10.
100
44
4400

4400) 33000 (7.5
30800
22000



35

300000

270000

18000)

18000)300000(16.

18

120

108

120

365

912

1.74 0.2405

10 1

365 2.2041

4446

365 2.

2.5

365.00

1597

30 2.5623

47.910. 0.1761

2.7384

.507,350 5.7050

2250 3.3522

2.13528

350 0.5441

225. 2.8969

788.

160 365 2.5623

24 1.3802

160 2.2041

6.1466

141 0000 365. 2.5623

2.50 0.3979

2.9602

2247 3.3519
450 2.6912
.6707

$\sqrt{4.68}$

365 2.5623

log $\sqrt{4.68}$ .6707
7.4377
8.1084 - 10
3.1084

.0013
.13

$\sqrt{4.68}$ .6707 139
3.5623
3.1084

1.2 1.1.92

1.0762
3.5623
3.0139

.0032
11

$\sqrt{11.92}$
10
14 11.94 1.0762
3802
.6960

$\sqrt{4.93}$

5/4
365
50
18.250)

18.25) 4.93

.6960
1.2613
1.4347

.27
1.2613
35 22
1.6135

41.10

18.250
.60
10.95000

18 | 37 80 00

51.5740
41.2553
1.3187

20.80

375,000 for central state

75,000 conductors

1 X 8 = 8
2 X 7 = 0
3 X 6 = 8
4 X 5 = 0
5 X 4 = 0
6 X 3 = 8
7 X 2 = 4
8 X 1 = 1

2
3
4
5
6
7
8
9

18 = 6x6

1000

365

2.74

50

$\frac{1}{18}$ of the time gas burned in day of 18 hours

$\frac{24}{140}$

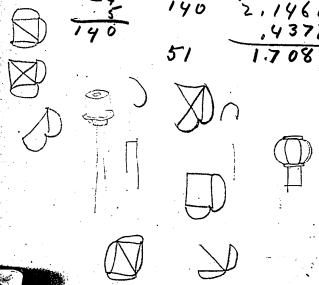
140

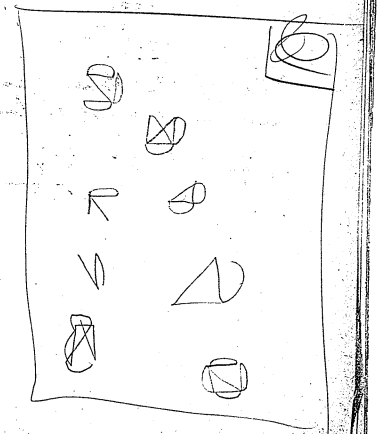
51

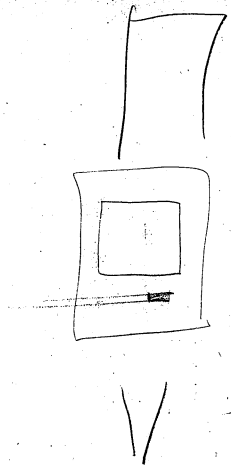
9.
2.5623
.4377

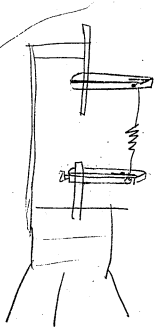
1.6990
.4377
1.2613

2.1461
.4377
1.7084



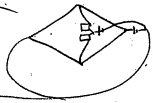


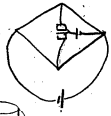


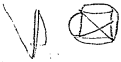


~~2.2356~~

Rt .362
10% .2552
.2739







1.35

15 90.

120,000

6000 66.60

126.60.

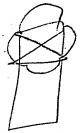
33
20
6.60.

18000

10.00

20 36000 38 for living

7000.



2.5	1.3522	10.2	1.0086	85.1	1.9304		
18.75	1.2729	17.4	1.2405	20.9	1.3201		
15.	1.1761	27.39	1.4376	17.9	1.1106		
12.50	1.0969	109.	2.0374	3.23	0.5092		
13.75	1.1383	17.4	1.2405	18.9	1.2765		
11.25	1.0514	25.82	1.4066	14.6	1.1644		
9.37	0.9717	104	2.0170	3.56	0.5514		
20.00	1.3010	2.87	0.4579	11.4	1.0569		
10.	1.0000	19.4	1.2878	11.4	1.0569		
8.75	0.9420	36.2	1.5587	5.7	0.7559		
8.12	0.9096	475	2.6720	1.41	1.6126		

log 31.103

c 1 mg. = $\frac{1}{31103}$ oz troy — 4.4928 — 5.5 0.72 −10 — 5.5 0.072

= .0000321 oz

100 mm. = 3.28 ft — log 328. — 2.5159 — 10.4841 −10

$\frac{1}{.328}$ = 3.049 — log = 0.4841

3.049 times as much wire in 1 foot than in 100 mm.

9) 100 mm of wire weigh 1 mg
1 ft of same will weigh — 3.50772 — 0.4841 — .00098 oz — 5 99.13

73 X 480 = grains — log 480 — 2.6812

oz X 31.103 = mg — log 31.103 — 1.4928

Ohms per foot ÷ mg in grain — 84.8 — 1.8116

Ohms X 3.28 = 1.64 — log 1.64 — 0.2148

4.6	2.6710	.072	2.8572	2.1.5	1.3305		
3.9	2.5917	.061	2.7891	12.5	1.1053		
3.1	2.4999	.048	2.6833	7.86	0.8958		
2.6	2.4157	.040	2.6041	1.9	0.2944		
2.8	2.4571	.044	2.6435	11.6	1.0617		
2.34	2.3698	.036	2.5833	8.9	0.9496		
2.	2.2905	.030	2.4799	2.17	0.3366		
4.2	2.6208	.064	2.8092	43.5	1.6390		
2.9	2.3188	.032	2.5072	6.8	0.8324		
1.8	2.2608	.028	2.4992	3.4	0.5311		
1.6	2.2284	.026	2.4168	.25	1.3980		

Wt per foot in oz — foot in oz — foot per Ohm

.00099	4.9999	1000.	3.	.046	2.6695
.0017	3.2318	588.	2.7681		
.00268	3.4289	378	2.5778	.078	2.8945
.0107	2.0287	93	1.9713	.123	1.1042
.0017	3.2318	586.	2.7682	.210	1.7056
.00250	3.3978	400	2.6022	.086	2.9383
.01102	2.0083	91	1.9917	.113	1.0504
.00028	4.4492	3500	3.5506	.46	1.6634
.00198	3.2791	520	2.7209	.023	2.3611
.00355	3.5500	282	2.4500	.147	1.1679
.0046	3.6643	221	2.3357	.294	1.4689

Wt per foot in grains — Wt per foot in oz — 5.07 — ft in 1 grain — .7020

.48	1.6811	31.	1.4927	2.088	0.3189
.825	1.9160	53.	1.7243	1.23	0.0870
1.26	0.1007	83.5	1.9217	.776	1.8899
8.12	0.7099	533.	2.7275	.79	1.2981
.8.2	1.9136	530	1.7246		
1.20	0.0790	787	1.8965	.834	1.9210
4.89	0.6895	320	2.5011	.21	1.3205
.13	1.1304	88	0.9420	1.8	0.8695
.81	1.9603	59	1.7719	1.11	0.0396
1.70	0.2312	110	2.0928	.587	1.7686
22.2	1.3455	1470.	3.1671	.895	1.6540

1.)

1.6496	44.6
1.1923	15.5
0.7877	6.18
$\bar{1}$.3945	.893
0.1497	14.1
0.8703	7.43
$\bar{1}$.6471	.444
2.5085	322
0.9718	9.37
0.2999	2.00
$\bar{2}$.0525	.0113

1.8378	.688
$\bar{1}$.3807	.24
$\bar{2}$.9765	.0946
$\bar{3}$.7729	.00592
$\bar{2}$.3371	.217
0.9687	.1877
$\bar{3}$.8355	.00688
0.6969	4.97
1.1602	1145
$\bar{2}$.4888	.0308
$\bar{4}$.2409	.00017

2000

$156\overline{)2000}$.

.3010
2.1895
2.1938

3010
1875
2.1135

2.1645 .015 c

1897

.3010
2.1875
2.1135

2.1645
3.8855 cts
1.0687

1.0687 13
36355
1.23332

2.1645
9313
1.23332

17.1

@ 5.6694
1.3222
3.0216

4.1265

4.5317

71.4 1.8537
0.2148
1.6389

6.8103
5.7820

360

Cost per foot 6.8103
feet per Ohm 1.3010
Cost per Ohm 4.1113

Cost per @ $2000 Log = 1.3010
Wt. per 1000 mm in mg. 2.87 0.4579
1 foot of wire weighs per foot 3.9913
4.4492
cost per foot 1.3010
feet in Ohm 3.7502
3.13612
cost per Ohm 4.1114
.000129

43.5 Ohm = 1 foot
1 foot weighs 1.6389
4.4492
1.6389
8.8103
1 Ohm weighs oz 5.1897
in 100 there are Ohms 1.3010
cost per Oz 5.1897
4.1113

50 cts per hour for 100 lamps

6 for H.P. H.P. costs 2 cts

$\frac{100}{6}$ 2 cts = 33 cts

~~50 cts. per hour for 100 lamps~~

$600 for machine

$60.00 a year interest

365)60 1.7782

2.5623

1.2159

50 cts

3 hours each day .164 interest per day

.164 interest per day

$0.5 cts per hour for interest

a lamp burned 3 hours each day cost for gas at $1.50 per 1000

$\frac{1000}{15}$ 1.50 =

15 | 3.30 +1.50 $.90

1000 | 200 | 40 $.40

400 | 9.0 | .02

4.9

$\frac{1000}{5} = \frac{9.0}{1000} \cdot 1.50$

$\frac{1}{200}$ $\frac{15}{20}$

1.00 1000 $\frac{15}{20}$ $\frac{3}{4}$ ct per hour

5 $\frac{1}{200}$ $1.00 per thousand

1.5 at 3 hours

100 lamps

1.50 $1.50 $1.50 per evening

$1.50 for evening

100 365

182.5

547.50

100 lamp machine

Supposing as in the case of street lamps which ~~these are~~ burned 10 hours a day gas 100 per 1000 5 cts each 100 lamps ~~$5.00~~ 50 cts per hour 2 ct each ,50

H. P. 1.5 ℔ per hour

6 lamps per H. P.

100/6 1.5 cts ~~$9.00~~ per hour for H. P. and exp ~~fuse~~ 25 cts per hour

$600 for machine interest and repairs $75

75	1.8751
3650	3.5623
	2.13128

.0205 cts per hour for interest on machine

Lamp costs $3.00

$300 for 100

$30 interest

Conductors for street lamps since the lamps may be put in series and have low resistance in each

$25 in all

$ 300	7.4771	
3650	3.5623	
~~.0823~~	3.9148	Lamp
.00823		

$ 2,5	0.3979	
.000684	3.5623	Conductors
	4.8356	

12 lamps a year broken

$36	1.5563
3650	3.5623
	3.9990
.0096	

Total

H. P and Central Station running & fuses 25

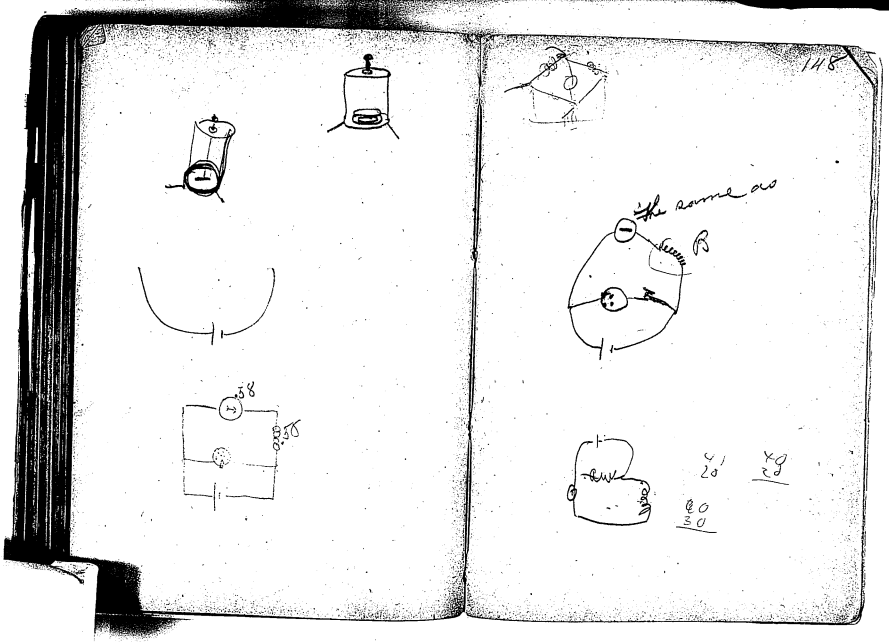
205

823

96

28971

30 cts.


118
the same as
B
A
20
30
40
50
60
70
80

.00142 grains = how many Grammes

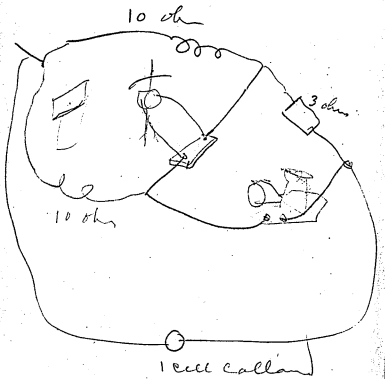
.00142	$\bar{3}.15229$
.06479	$\bar{2}.81104$
	$\bar{5}.96335$

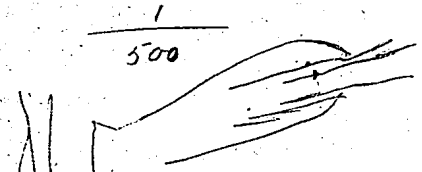
.0000919

.00001021 - Grammes of H.

Jenkin's alloy

.00092


10 ohm
3 ohm
10 ohm
1 cell callan

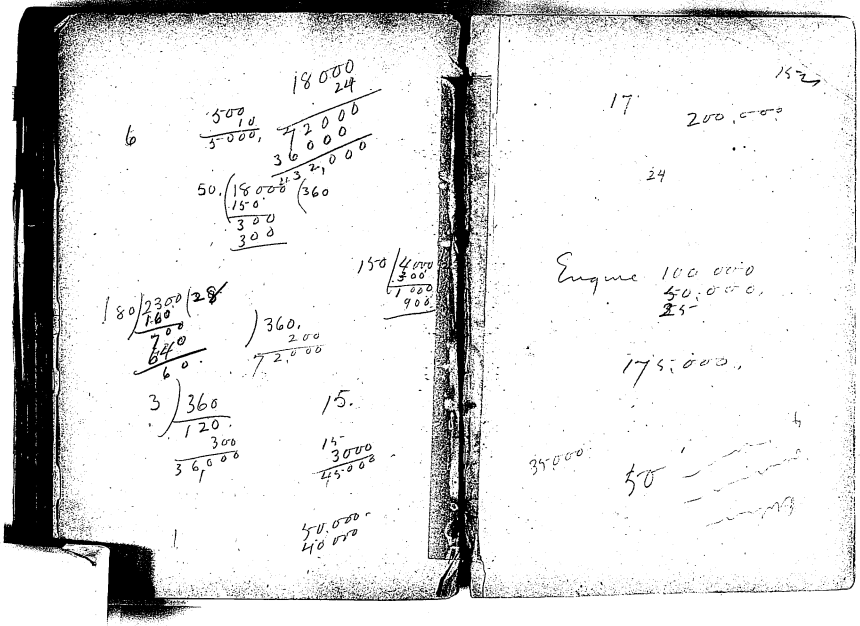


1	1.00
2	50
4	25
8	12
15	6
32	3
64	1 1/2
128	.75
256	.37
512	.18
1024	.09
2048	.4 1/2
4096	2 1/4
8192	1 1/8

16,350

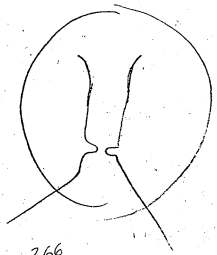
8000, 4 inch wide
100,000 of 1000 about

151



15½ — 90.

6000 feet for 1 dollar



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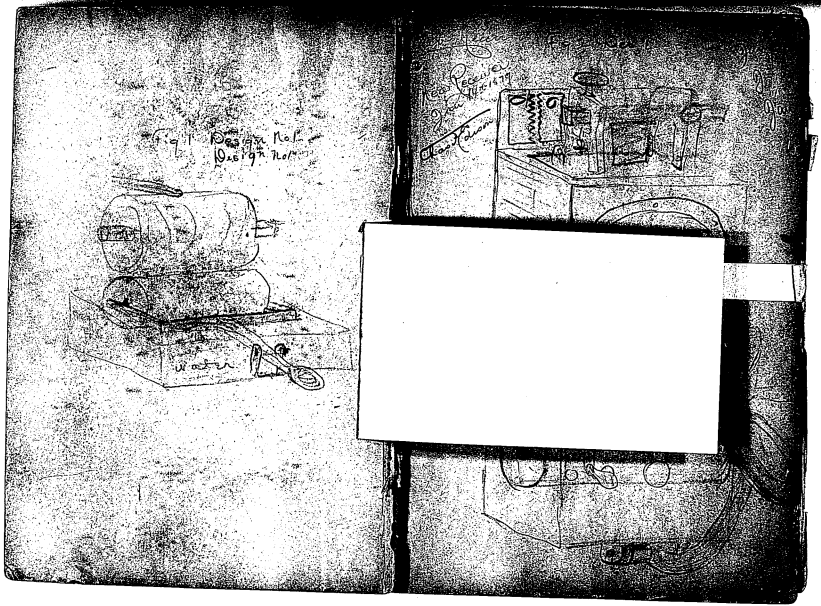
Menlo Park Notebook #24 [N-79-01-14]

This notebook covers the period January 1879-January 1880. The entries are by Edison, Charles Batchelor, Francis Upton, John Kruesi, and Charles P. Edison. The name of John Ott appears occasionally as a witness. Most of the material relates to electric lighting experiments. Included are drawings of lamps; calculations and drawings of generators; and calculations and notes by Kruesi on the design of dynamo machines, numbers 5-10. There are also notes and drawings of the telephone, including a patent office model; a draft letter by Edison to the Scientific American about the telephone; notes by Kruesi on equipment for the Edison Ore Milling Co., Ltd.; notes and drawings by Kruesi of shafting and belting for the extension of the machine shop; and notes by Batchelor on things to be done. The label on the front cover is marked "Telephone Sketches." The book contains 280 numbered pages.

Blank pages not filmed: 60-61, 66-71, 108-109, 112-113, 136-139, 154-185, 200-277.



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GENERAL ELECTRIC
, 189

Fig 3 Rev 1

New edition
gamma 14th 1977
Chas. F.

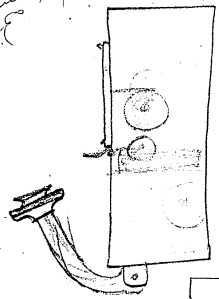
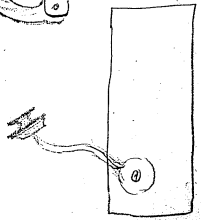


Fig 4 Rev 1



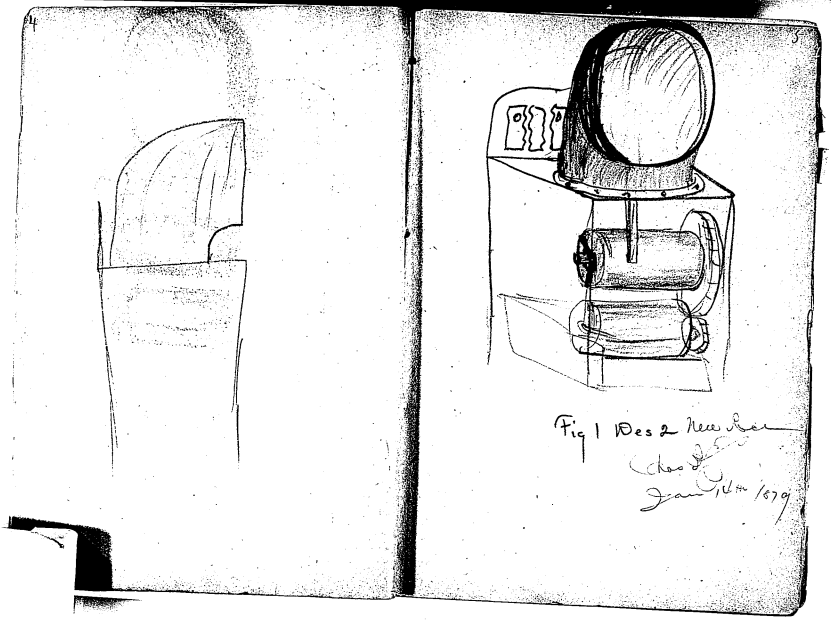


Fig 1 Des 2 Nees Ree
Jan 11th 1879

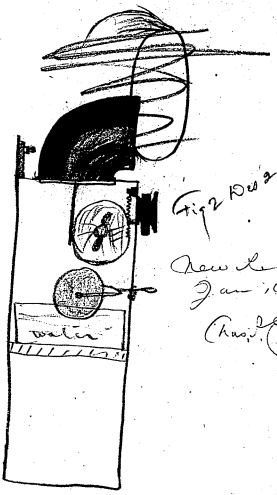


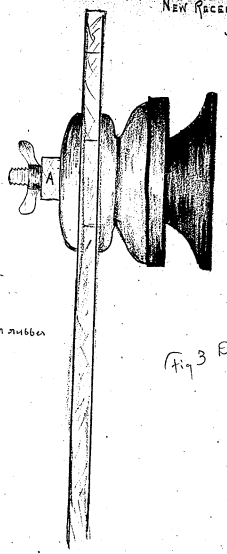
Fig 2 Duo

Jan 14th 1879

8

9

New Receiver
Jan 14th 1879
Crookes

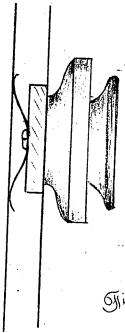


A - gum rubber washer

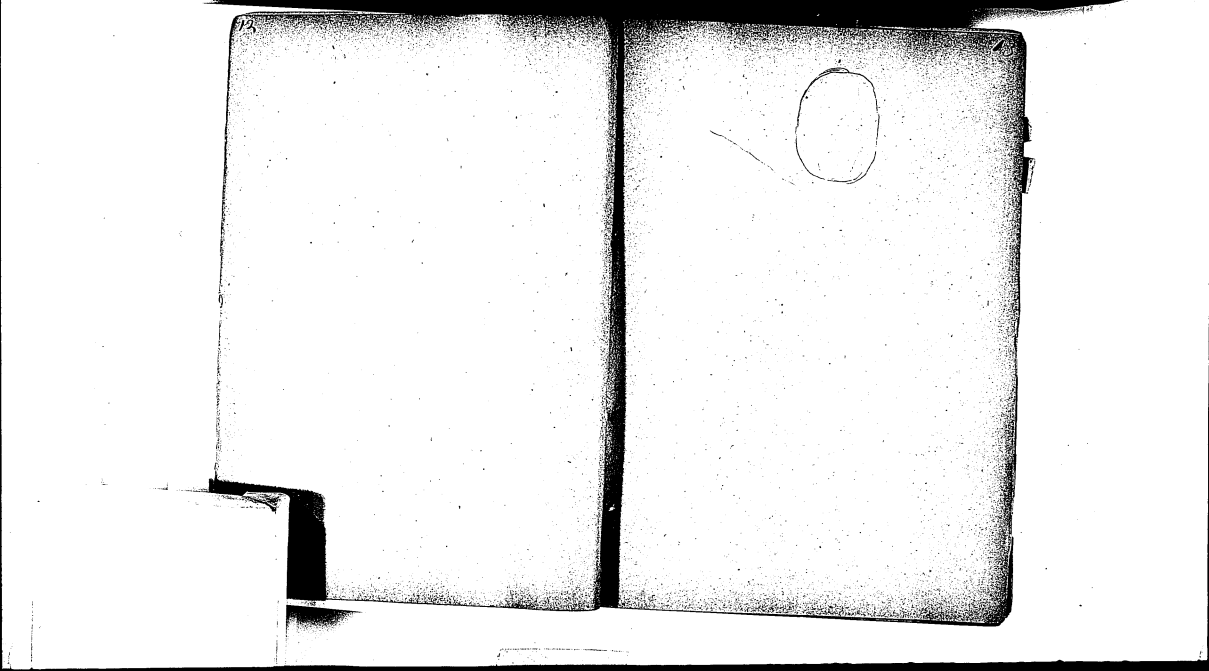
Fig 3 Doc 2

7

New Secretion
Jan 14th 1879
Chas. S. Pierson



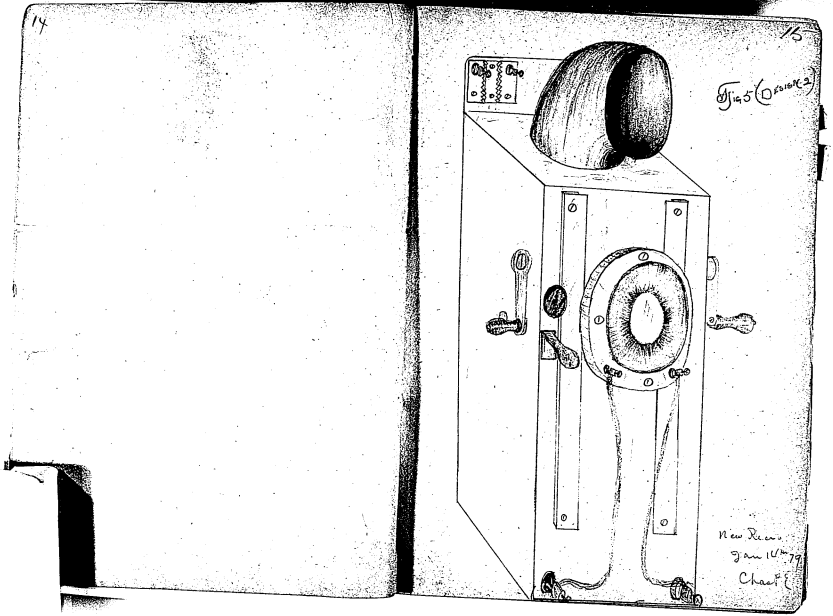
Thigh & Buttock Mg 2d



14

15

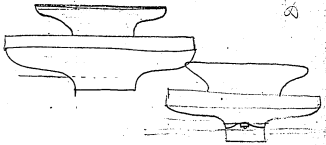
Fig 5 (Obverse)



New Rieme
Jan 14th 79
Chas F

16

Menlo Park N.J.
June 14th 1879
Thos. A. Edison



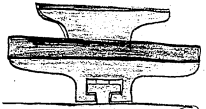
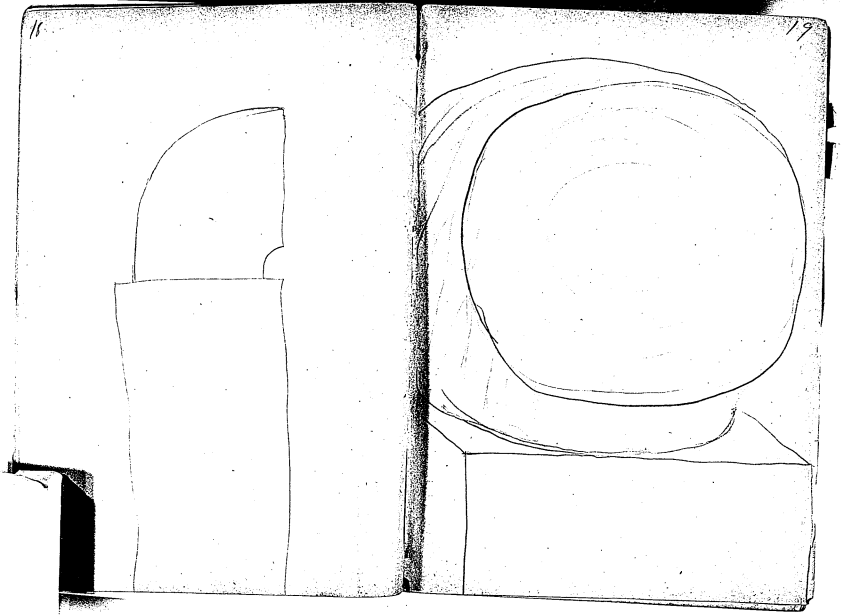


Fig 6 (Rec'd)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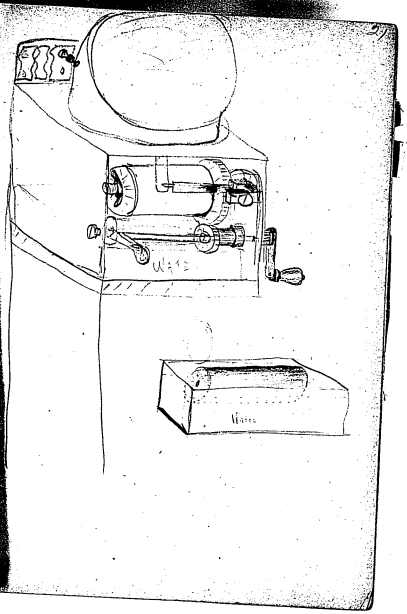
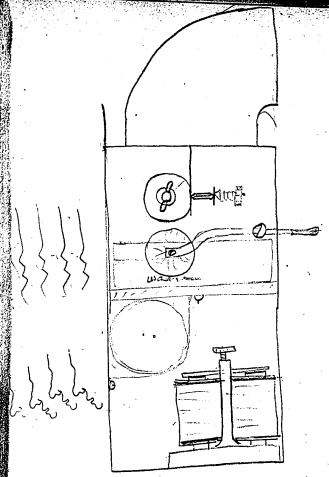
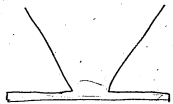
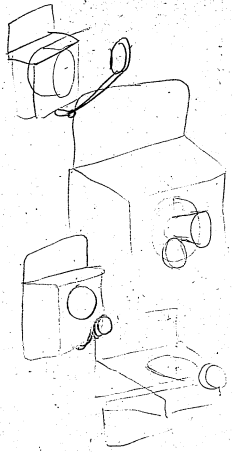
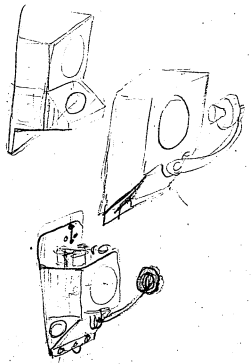

Water



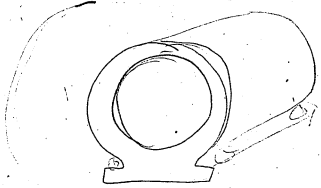


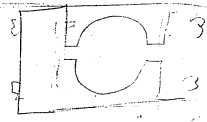




Pages 31 to 48
Explosive Shell Fuze
Investigation

No 1

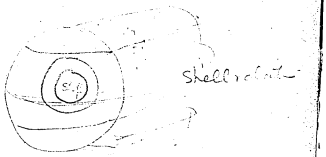




No 2.

hold the fixed magnet still & rotate the wire,

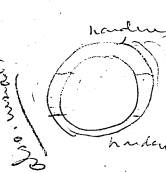
No 3.



No 4.

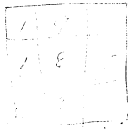
rotate ~~axis~~ wire ~~only~~ & needle + time together —

make a ring of permanent magnets

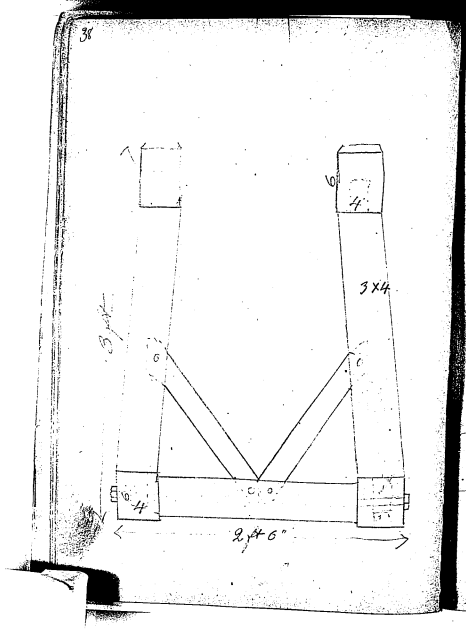


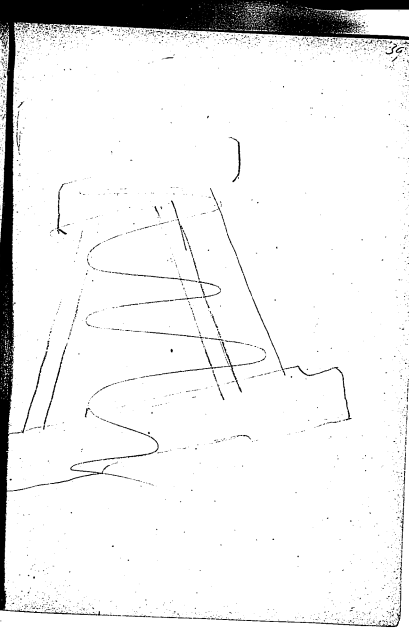
Cylinder steel =
1/2 5-

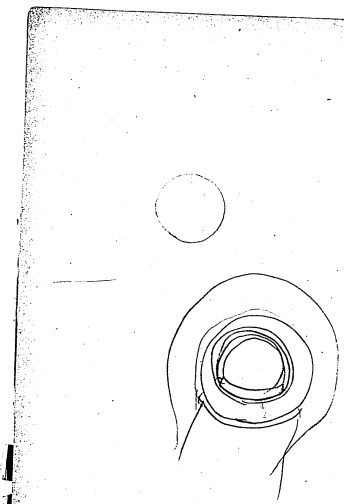
Rotate wire + cylinder

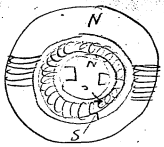


Write Harris for Johnsonhill 37
Write Johnson
Write Fullerwinds Shire. Conf
See Parker. Can he made 7
Gaffer Wade


4"
3x4
4
C.L.O.
2'-4 6"



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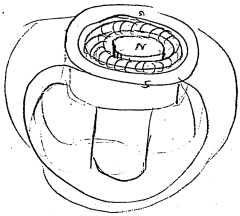
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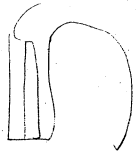
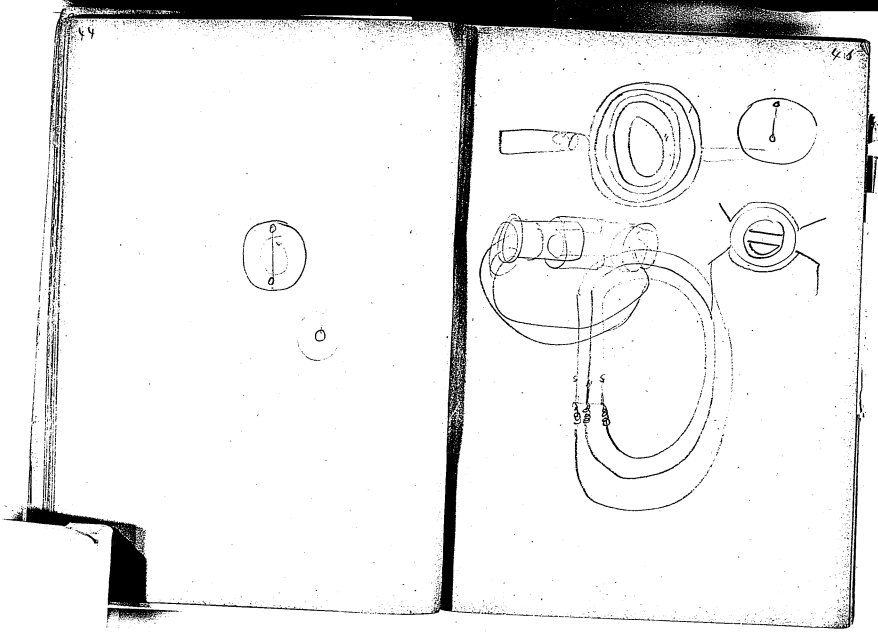
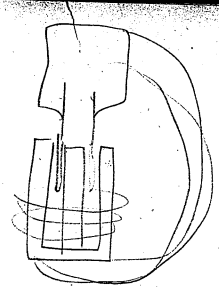
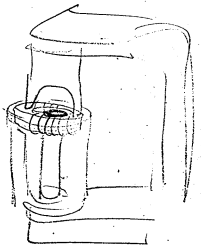
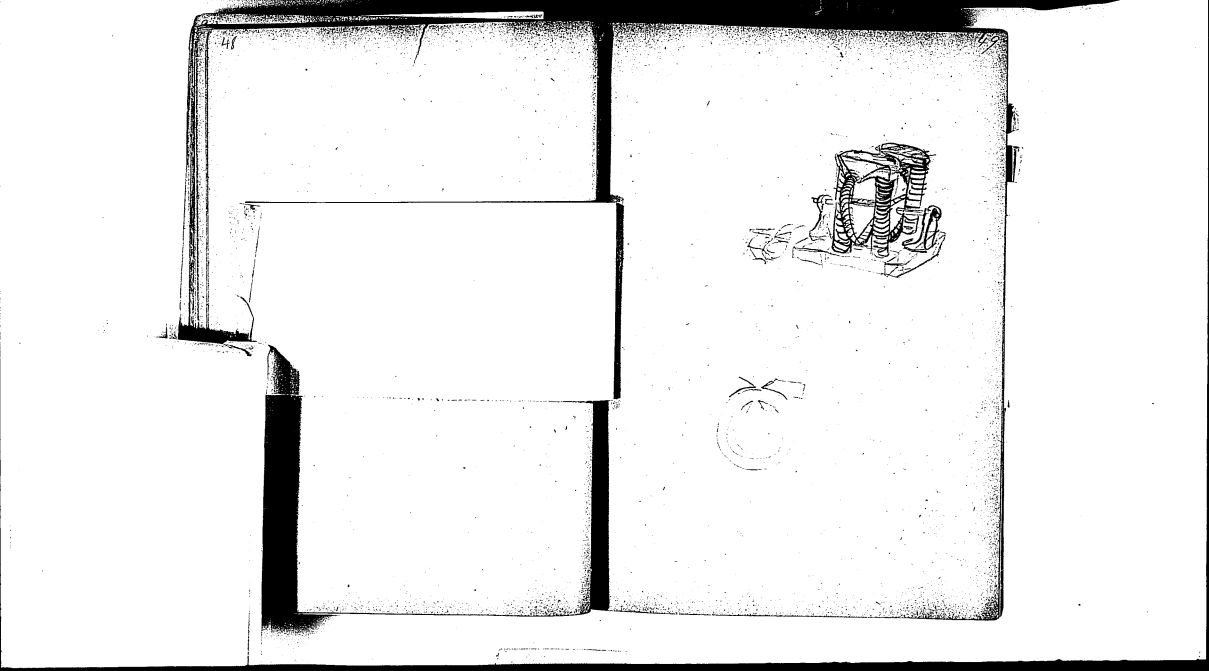
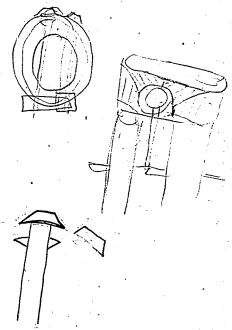


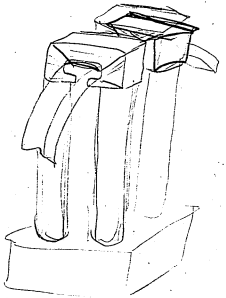


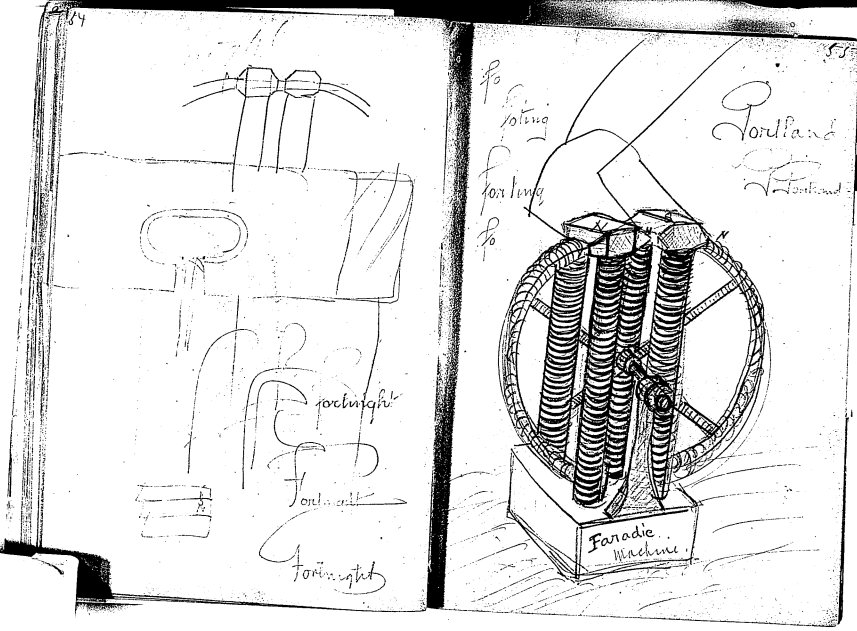


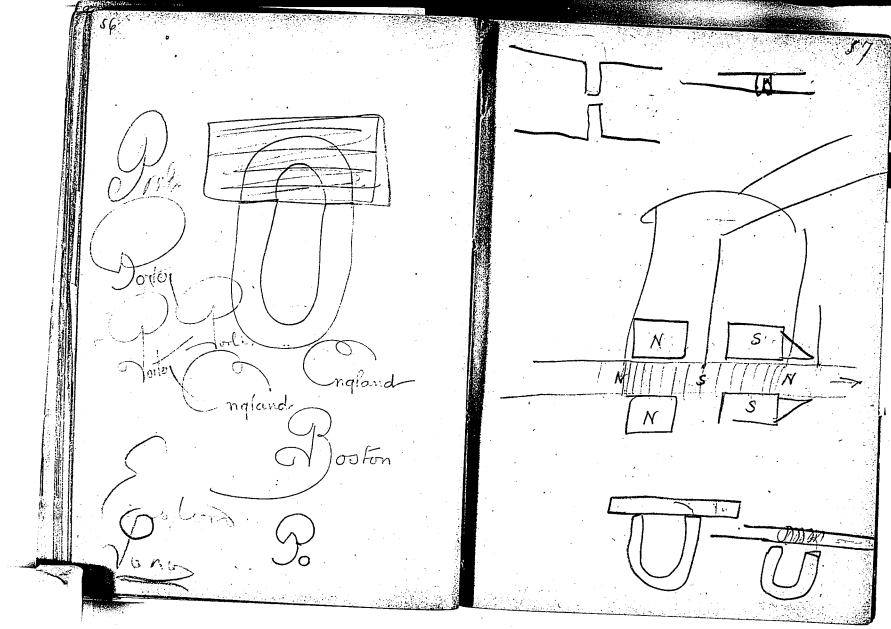









Portugal
Faradic
Machine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58

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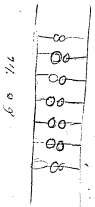

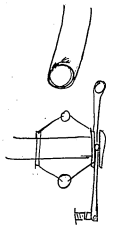

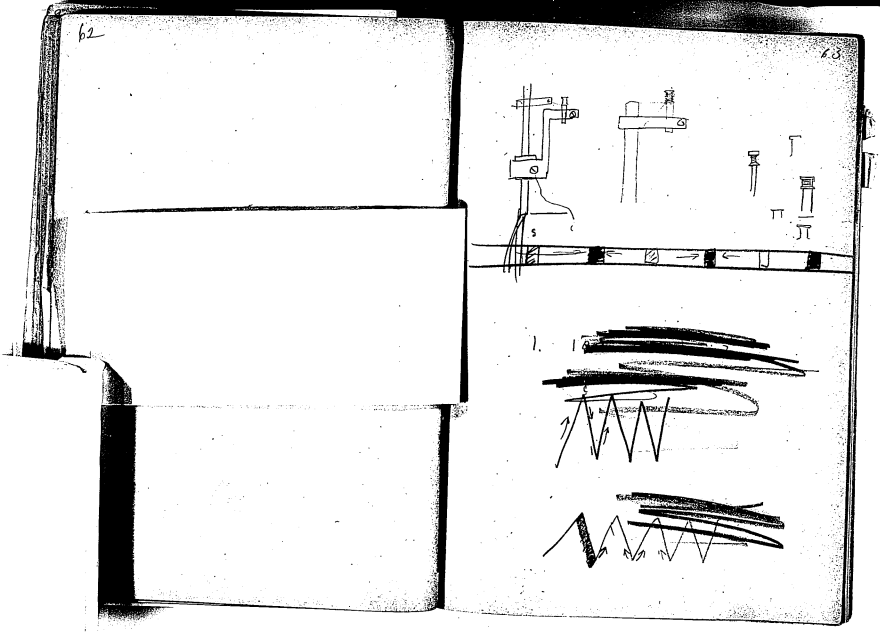
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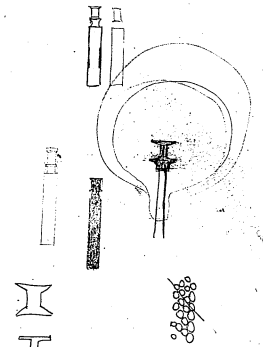
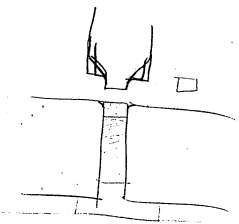
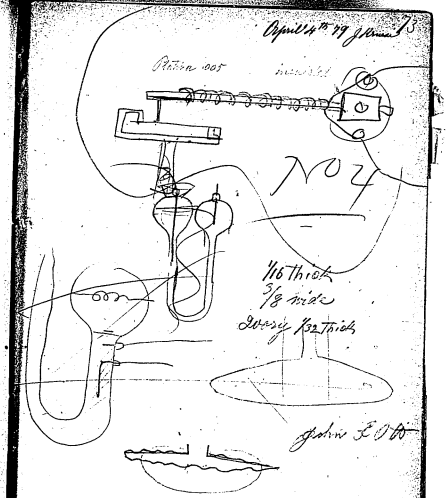
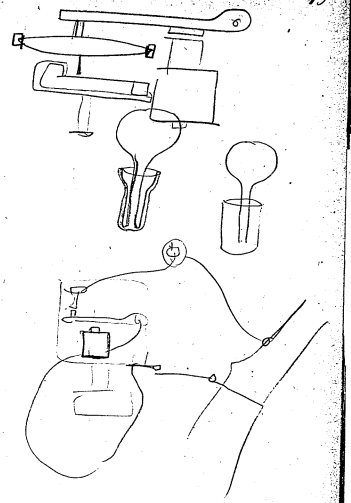
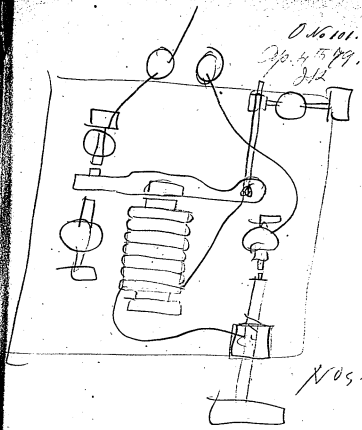





Platina wire
No 4
1/16 Thick
3/8 wide
2 Brass Rod Thick
Glass Tube





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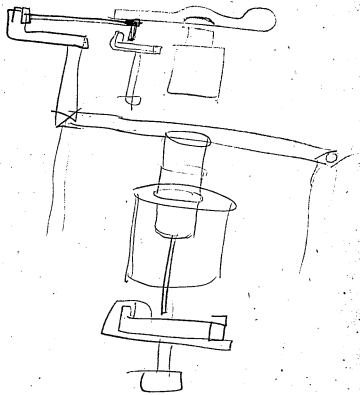

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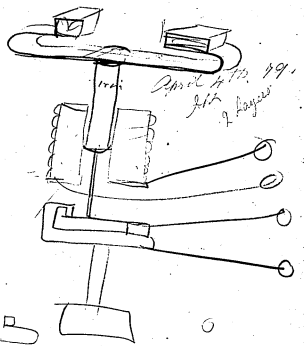
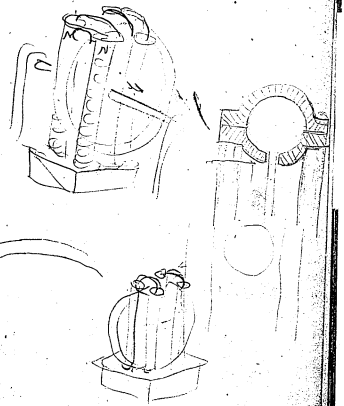


No 6a

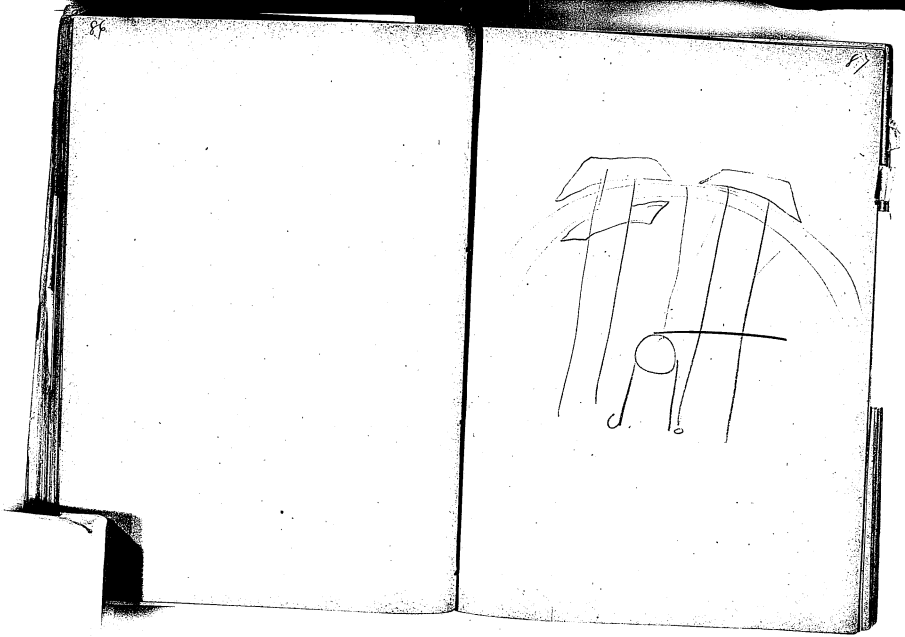
April 4th 59
JK

Model

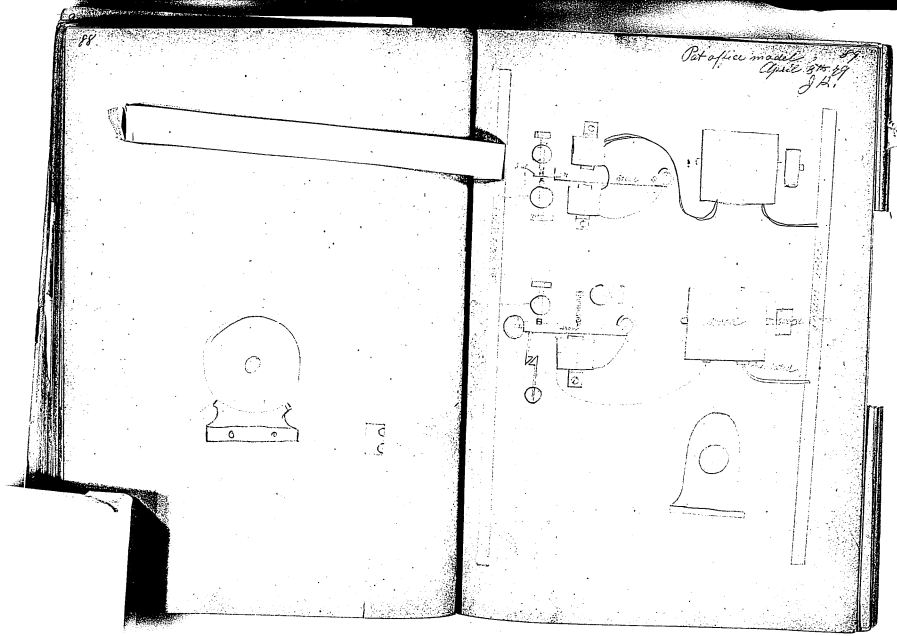


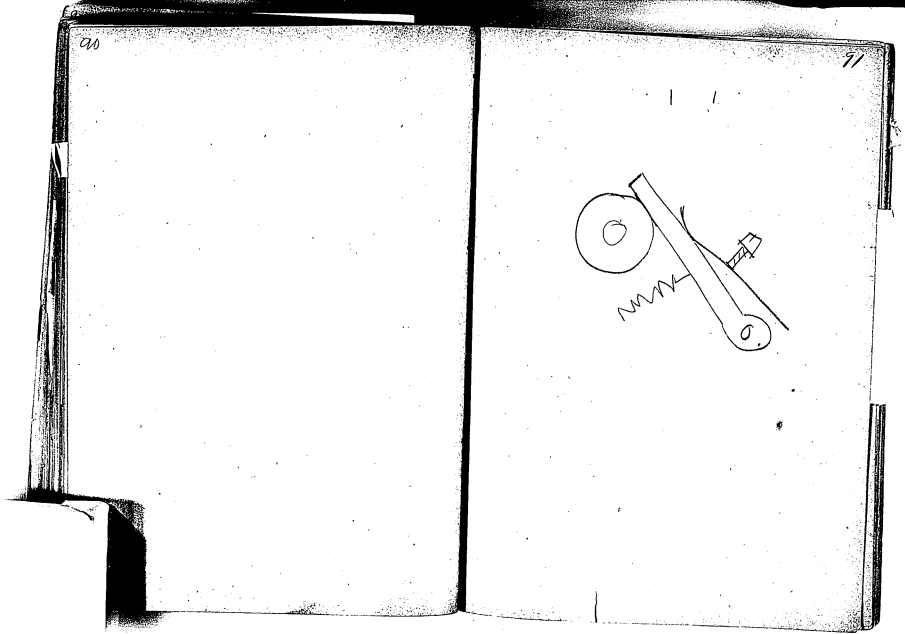
To the Editor of the S A.

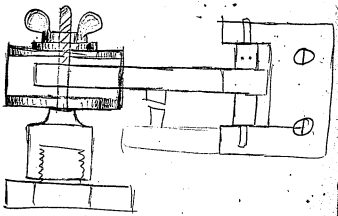
The Righi telephone which you describe and illustrate in your journal of March 22 1879 ~~is precisely the same apparatus was introduced after [illegible] which~~ is exactly similar as the one I first introduced in 1877. ~~As~~ When Prof Righi first observed his telephone Count Du Moncel called the attention of the academy of sciences to the exact similarity between the two.

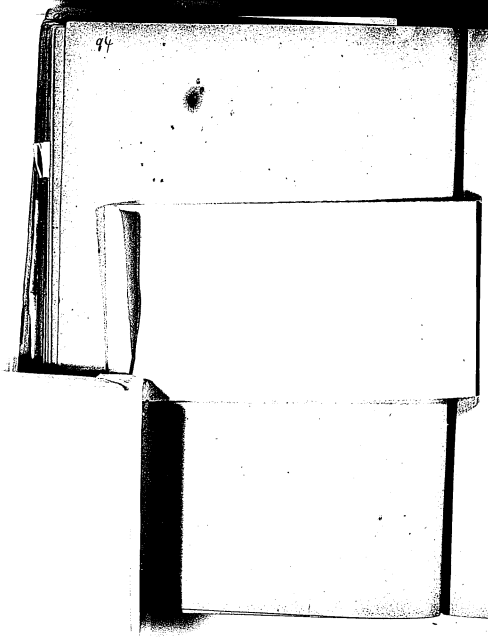


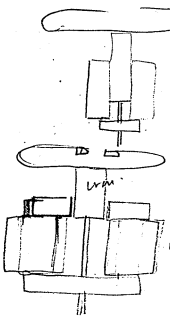
Post office model
Opened 9th Mr 89
J.P.







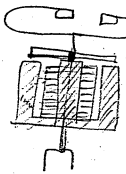




First already made

2nd
17 wire 3 Pairs

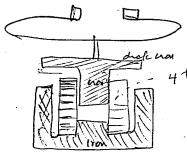
Over



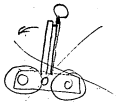
disk of iron
3 layers
N° 17 wire.

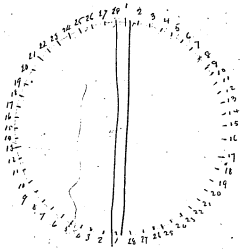
98

99

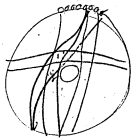


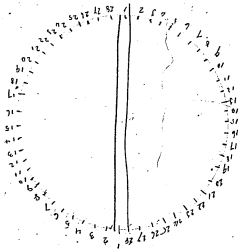
- 4 Pages no 17





23 feet 2





38
49
342
152
1862 = 155
10
310
155
140 | 1860 = 13
460
420

484
3
1452

1255 | 118 1452
1225
1452
118
11816
1452
1452
1225 | 1227336 = 140
1225
4883

49 | 400 9
392

16240
9
1680

9 | 38 4.2
36

38 inches of wire to one turn
49 coils

Volt 10 ⇒ 1 Weber
10

9)11 (1.2
9
20
18 Volt

8)12 (1.5 w
8
40

7)14 (2.

6)20 (3.3

5.7)30 (5.2 Webers
285
150

5,55)40 (1,6021
5,55 .7443
.8578

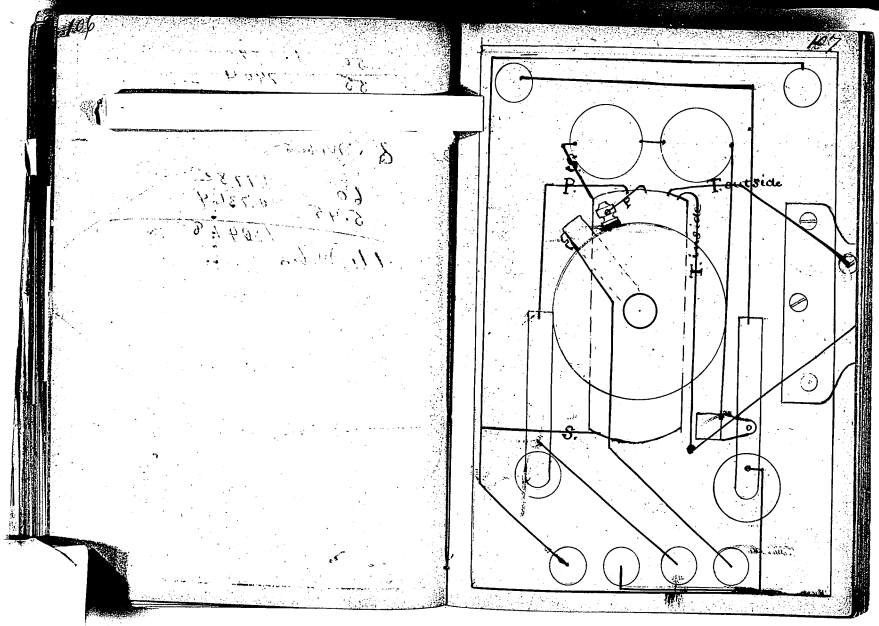
7.2 Webers

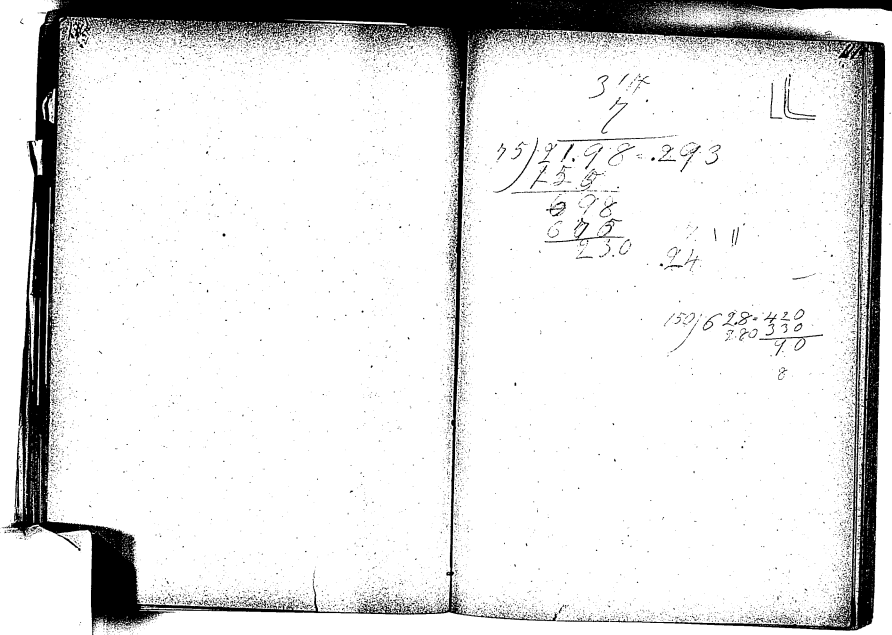
50 1.6990
55 .7404
.9586

8. Webers

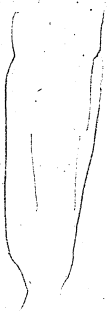
60 1.7782
5.45 .7364
1.0418

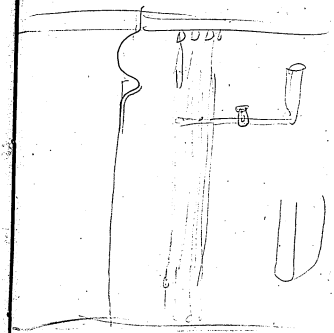
11. Webers

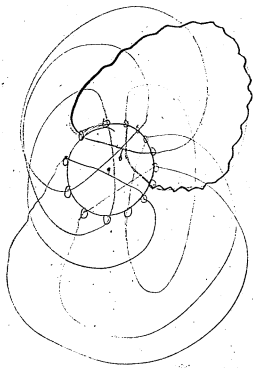

P.
F. extérieur
F. intérieur
S.


3 1/4
7
45)13.98 .293
135
98
90
8
2.30 .24
150)628.420
600
280
270
120
8

No sir they did not come on.







Connecting wire,

2.38 –

2nd least	1st least	3rd least
114	49	37
108	38	26
103	24	9
96	32	20
83	51	39
77	65	53
64	51 1/2	39 1/2
51	37	25
37	21	9
	21	9
	37	25
	48	36
	64	52
	77	65
	88	77
	99	87
	106	94

112	100
116	104
118	106
118	106
116	104
112	100
107	95
99	87
92	80
82	70
71	59
58	46
44	32
29	17
14	2
31	19

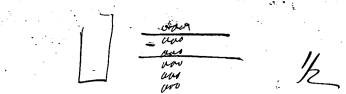
46. — 34
56. 44.
71 59
83 71
94
107
114
117
118
117
114 —

9.5 inches bore of

Inside diameter of iron 6.25 inches
8.58

Outside

9.50
8.58
.920



1/2

1/4 1/12 9/12

3/4 Ohm

62 .000 3/4

130
40
170
920 92

17)92 (5.4
85
70

1/5.4

5.4/6 = 9

124

$\frac{920}{460}$ 5 $\frac{1}{2}$

$\frac{65}{20}$ $\frac{1}{12}$

$\frac{85}{}$

$\frac{460}{85} = \frac{92}{17} = 5.4$

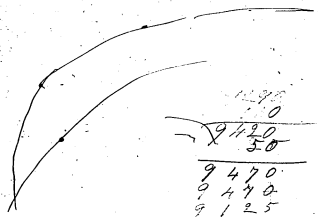
$\frac{6}{5.4} = .9$

9

675

137.68 ft pr. stone

125



1 stone 37.190 inches

3

111.57

75

36

1.27

4) 5.07

12) 8367.65 - 1374 697.3

116 688 0

87 9.300

36

2323) 697.3 = 3

6969

With speed Dia of smallest

Constant 5400

12)125.000 = 104.060

21

30

5400 | 104.0600 = 19

5400

5007

21

6

36

24

2200 | 16.70

8 : 3

80

14

2200

383

6600

17600

6600

5400 | 8426.00 = 160.5

3021

216

2200

383

6600

17600

6600

37.19

36

6

16

24

2200

24

8800

4400

528.00

383

158400

422400

158400

5400 | 202224.00 = 37

162

402

54 | 52800 | 9

432

1 60 ft. 3½ inch Shafting with 1-3½" Couplers
3" shafting in Shops
2 hangers 30" drops - for 3½" Shaft in Shops
1 — pulley 60 diam. for 24" belt on 3½" "

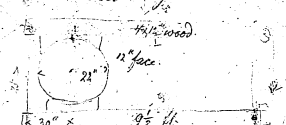
5 hangers 26" drops - for 3½" Shaft.
26 ft. 3½" Shaft.
1 — pulley. 36" diam. for 24" belt on 3½" Shaft
10 — " 32" " " 5" " " 3½" "
1 — " 31" " " 12" " on 3" Shaft.
10 or 5 — " 32" " " 5" " " 3" "
20 ft. 3" Shaft. with

5 — 1" - 2'-9" long bolts for trusses
10 - ⅞" - 1'-9" " " " "
10 ⅞" - 1'-6" " " " "
20 - ¾" - 1'-8" " " for hangers & Shafting

44' × 20 - 5" belt
43 - 24" belt
27 - 12" belt

2 doors.

Cloud Engine.



150 ℔

50 revs. = 30 "
30 revs. steam
50 revs. 150 ℔
10 " steam "
50 " 300 ℔ on brake
steam raises 150 ℔ in 10 seconds
50 + 300 ℔
Figure Alone
Stop system
Remarks by Hasbrouck.

22" circumf. = say 69" at 5¾ ft. per
5.75 ft. at 50 revs. = 288 ft. per min.
say weight of brake on 22" pulley = 360 ℔
Weight of Wood weight on wheel 170 ℔ 170 ℔
Ratios of Brake alone = 500 ℔ above ℔ on ℔
(Cast iron) (Steam load)

50 ℔	= 240	+ 400	= 640	= 50 to 23
100	= 480	+ 400	= 880	= 50 to 23
150	= 720	+ 400	= 1120	= 50 to 23

185 ℔ on brake = 888 ℔ at 0.14 ft. 5 pt. revs. per min.
Standard on all = + 400 ℔ by brake weight
1288 ℔ × speed 288 ft. at 50 revs.
288
10304
10304
2576
370944 = 11½ H.P. to 12 H.P.

1 H.P. = 550 ft. lbs.

185 ℔ on brake consisting of brake weight
888 ℔ × 5¾ ft. = 0.185 H.P. at 50 revs. per min.

800 ℔ brake alone = 0.87 H.P. per min. ℔ = 800 H.P.
or at 20 revs. = — 20 rev = 1.7
at 30 revs. = — 30 rev = 2.1
at 50 " = — 50 rev = 3.5

640 ℔ at 50 revol. of 5.75 ℔ = 184,000 ℔.
640 " " 30 " " " = 110,400 " "
Due to air 73,600 " air

880 ℔ at 50 revol. of " " = 253,000 " "
880 ℔ " 23 " " " = 116,380 " steam
Due to air 136,620 " air

1120 ℔ at 50 " " = 322,000 " "
" at 2 " " = 47,120 " steam
369,120 " air

640 ℔ at 50 revol. = 5.5 H.P. =
400 ℔ at 50 " steam = 3.48 " }
240 ℔ at 50 " air = 2.09 " }
700 ℔ at 30 revol. = 2.1 H.P.

880 ℔ at 50 " = 7.66 H.P.
400 " at 50 " steam = 3.48 } =
480 " " 50 " air = 4.18 }
405 ℔ at 23 " = 1.6 H.P.

1120 ℔ at 50 " = 9.75 }
400 " 50 " steam = 3.48 } =
720 " " 50 " air = 6.27 }
400 ℔ at 2 = 0.14 H.P.

If air were not progressively expanded as it is heated, it would require 5 times as much steam as it does to perform the same work.

Air compressed quickly - $\frac{1}{5}$ gives fire - 290°
while Steam 1700 times compressed blows only 500°
Average Water absorbed in air - $\frac{1}{100}$ part.
Heat capacity (Specific Heat) for equal Volumes
Air - 1000 and Steam 1.980 at equal pressures
(Dalton) - 1.376 " Water 1.04 " expansion from 30° to 212°
(Thurston) Spec. Heat. At equal weights - air. 267 - Steam 475
or air. 1000 to Steam 1.776

Specific gravity of steam compaired with air 0.4809

At 60° - 1 Vol. steam - 75721 Vols. Volume
98 - $\frac{1}{3}$ " " - 69,372 " "
110 - $\frac{1}{4}$ " " - 16,667 " "
130 - $\frac{1}{10}$ " " - 13,255 " "
140 - $\frac{1}{15}$ " " - 7938 " "
212 - 15 " " - 1700 " "
276 - 45 " " - 610 " " with $\frac{1}{5}$ vol air at 60° &
252 - 30 " " - 875 " " combined temperature
265 " " or the steam increased
to about 1½ its Volume at $\frac{2}{5}$ its pressure
while air from 60° to 252° takes 1⅔ times its volume.

276°-3 Vol. Steam 1 = 4½ Vol. × ⅖ Press
60°-1 " Air 1 = 1½ Vol. ×

4 × 1 = 6 × ⅔ = 4

Latent Heat of Steam 990°
Specific Heat Water 1.000 - air 0.2669
774 Heat Unit — H.U.
226 cub" Air at 63° expanded to
455 cub" at 154° —

Steam reduced to 154° from Steam of ?

Air from 63° to 154° expands ~~from~~ = 70252 ft.
from 226 cb" to 282 cub inch leaving
from 455 cb" total = 173 cub" filled by steam at 154°

Steam at 154° = 4.1 lbs pressure same as shown in gauge by compressed air
Steam volume 5559 Cub ft. ~~from~~ at 154° from
" 1700 " " " 212°
Heat of Water in Kotwell = 100° at best advantage

Spec. Heat of Water 1.
" " of Steam 0.475
" " " Air - 0.267

	Latent		
Steam at 154° —	1006	total 1160	leaving (Cloud)
Water " " 212° —	966	" 1178	
" "			Steam supply
Air " 310 —	142.0		
Air - 63°			entering Cabin Top
" 154°			leaving (Cloud)

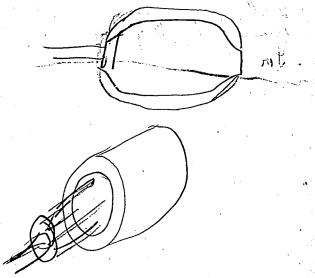
(Expansion of Air at 63° = 1.06 (at 15 lb.)
" 154° = 1.26

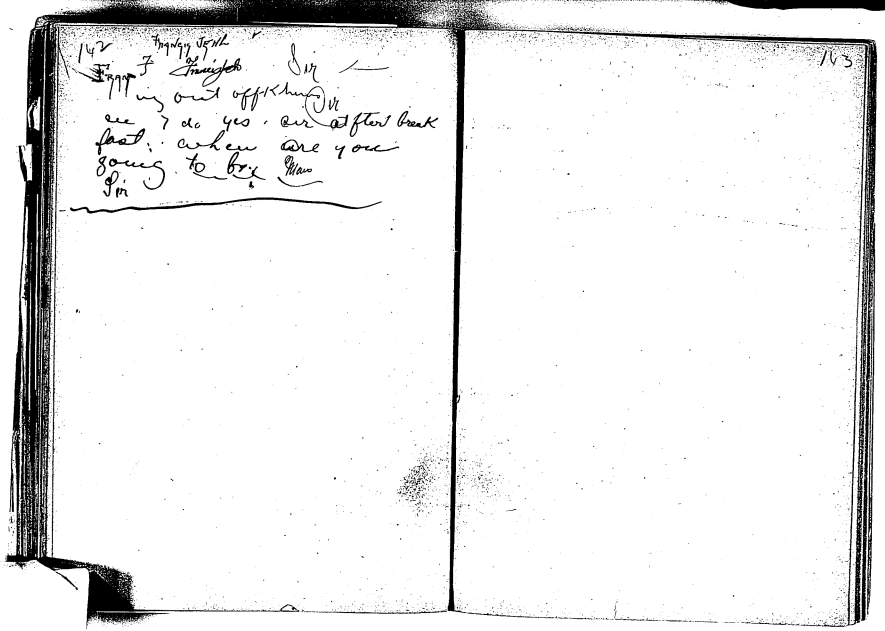
(Expansion of Steam at 154° = Vol. 5559 = 4.1 lbs. pressure
" 212° = " 1700 = 15 lb. " " "
" 63° = " 64752 = 3/4 lb. " " "

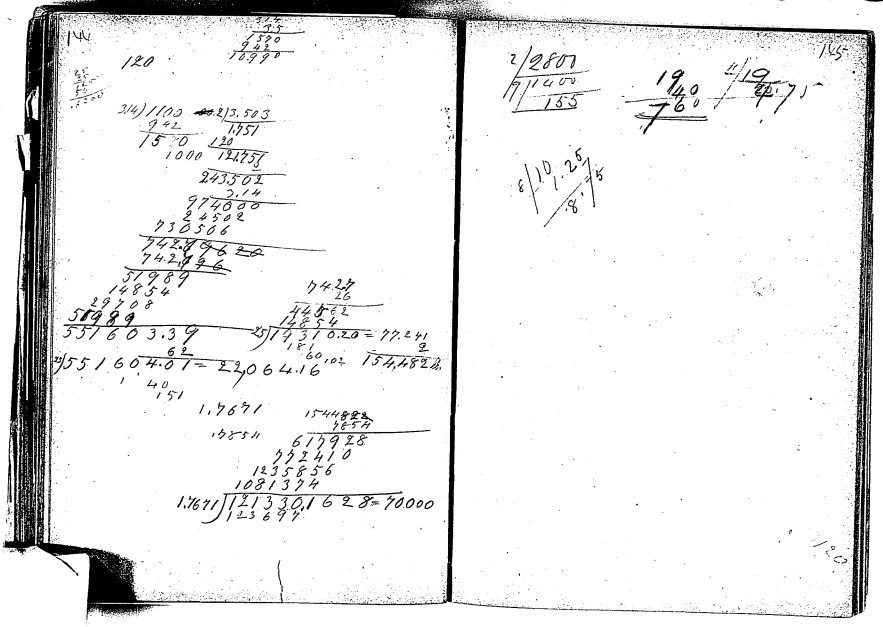
140

168 #. 53 #. 115— 55
—— 25

141







Bricks for M.L. Extension

27 × 1' × 8'	= 216	36 for windows
2 × 2½ × 8' × 8'	= 576	40 for doors
1 × 2½ × 12' × 8'	= 360	76
2 × 15' × 8'	= 240	
	1392 = 92 for openings	
	1300	
	22	
	2600	
	2600	
	26000	

Partial 2nd — 2 - 27 × 1' × 8' = 432

216	1948
432	76
360	1152
270	3364
1948	2596
22	768
2796	

26000 Bricks

2796 − 2508 = 288

36	
8	
288	

27 × 27 × 3' = 648

288

240

1170

1100

2800

2772.00

10 Hours of Engine

20 = 28 × 8 = 224 × 19 = 2016 + 228 = 2244 = 1348

3780

1893

33 = 33 = 1

6600 ℔

33000 / 22 = 1500

726 ÷ 22 = 33

14" / 5 / 70 = 14.0

80 / 24 / 1920

60 / 180

45 / 135

60 / 137

82" / 24 / 1968 / 168 / 2016 / 1440 / 288

452160 = 137

33 / 121 / 231

5 / 1 / 5

1500

5/8

40 = 17

60 / 36 / 240

Machine Shop Extension —

6 – 4"×6 – 8'-10" — 147.15'
6 – 2½"×6 – 8'-10" — 15'-6"
2 – 4"×6 – 9'-9" — 14'
2 – 2½"×6 – 9'-9" — 13'
2 – 4"×6 – 10'-3" — 13'
2 – 4"×6 – 10'-9" — 12'
2 – 4"×6 – 11' — 12'
2 – 2½"×6 – 12' — 15'
2 – 4"×6 – 11 – 10 — 12'
2 – 2½"×6 – 11 – 8 — 15'
2 – 4"×6 – 11 – 6 — 12'
2 – 2½"×6 – 11'-4 — 15'
2 – 4"×6 – 11'-3 — 12'
2 – 2½"×6 – 10'-6 — 14'
2 – 2½"×6 – 10'-7 — 14'

4"×6
✓ 10 – 12
✓ 2 – 15
✓ 2 – 14
✓ 2 – 14
✓ 2 – 13

2½"×6
✓ 2 – 13
✓ 4 – 14
✓ 6 – 15
✓ 6 – 15

2×6
8 – 4'

280.18
338.80
62.60
154.04
21.87
854.39

337.58
266.70
22.54
131.98
129.15
15.34
6.33
22.75
932.07
854.39
77.68

32.07
7
224.49
60

21'×20×5" = 420' – 57" – 237.40

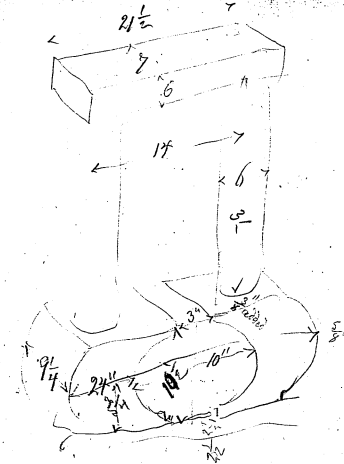
14'×20×5" cond. = 280' – 159.60

27' – 24" – 3.22

19' – 24" 60

355 : 60 = 28 : x
355 : 1200 = 48"
1005
200

150

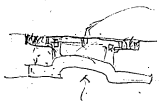


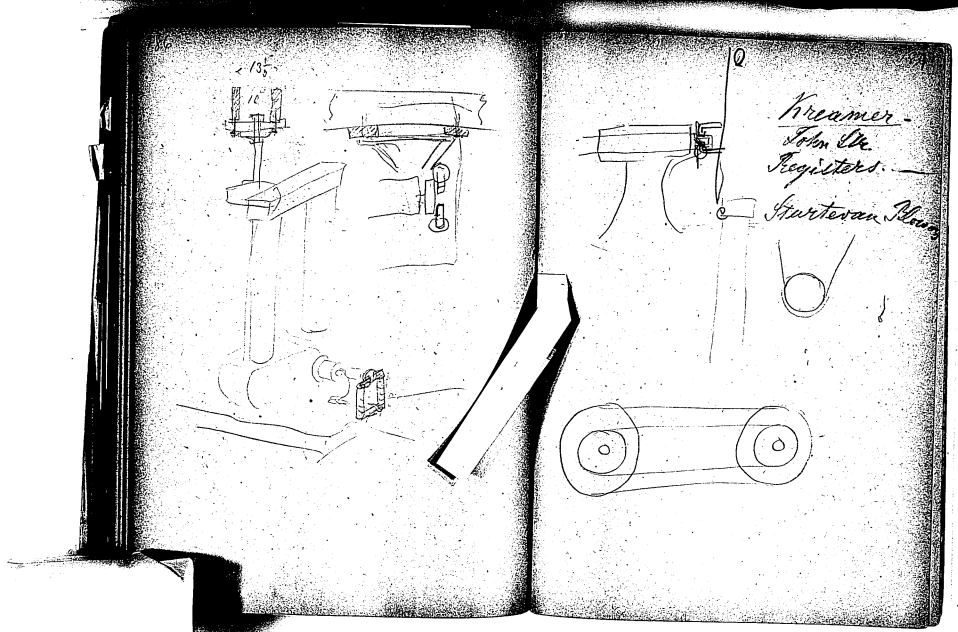
[redacted] Jan. 5th 1880 1-1

Faradic Machines 5, 6, 7, 8, 9, 10.

Diam. of bore —	9.75	10 —
" " Armature over all	9.87	9.92
" " " " iron	9.19	9.44
" " wooden core —	6.25	
" " Fibre cards.	9.67	9.92
" " Shaft.	1.75	
" " brass box outside	2 —	
" " " " iron flange	1.50	
" " " " inside —	1.50	
" " Pulley —	10 —	
" " " " Cover flange	12 —	
" " Commutator	5. —	

Armature length 9 3/4"
" to Commutator 2"
" to Pulley — 2½
Pulley — — 6"




135
10
Q
Creamer -
John Ste
Registers -
Starteven Plows

600
63
525
6
3150 acres
22.5
15750
6300
~~6300~~
~~36000 87900~~

36000 x 708750 2

36 acres
22.5
36
1350
675
315 x 810,000 acres 260
630
~~225~~ 1800

12

190

20" Diam. pulley = circumf. = 62.83

Belt contact about .25 of circumfer. = 2.1 ft.

Belt speed assumed 3150 ft. per min or 600 revs.

contant: $\frac{36000 \times 22 \text{ horsepower}}{3150} = 251.43$

$\frac{251.43}{2.1} = 120 : 6 = 20$" width of belt.

First machines, 5" belt on 10" Diam. 600 revs. representing 28 H.P., would require proportioning for large dynamos. 8" belt on 20" Diam. using about 3 times the H.P.

191

Yellow Pine timber to spare

5 – 4" × 12" – 27'

14 – 8" × 12" – 23'

6 – 8" × 10" – 12'

2 – 6" × 6" – 28'

6 – 10" × 12" – 10½'

5 – 10" × 12" – 12½'

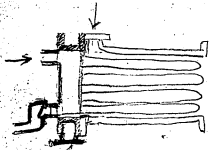
9 – 4" × 8" – 6'

4 – 4" × 6" – 4'

192

Machine Shop - Extension

6 - 7 x 6 - 8'-10" } from 4-17' and 2-15'
6 - 2½ x 6 - 8'-10" " 15'-6"
2 - 4 x 6 - 9'-9" " 14'
2 - 2½ x 6 - 9'-9" " 13'
2 - 4 x 6 - 10'-3" " 13'
2 - 4 x 6 - 10'-9" " 12'
2 - 4 x 6 - 11'- " " 12'
2 - 2½ x 6 - 12'- " 15'
2 - 4 x 6 - 11-10" " 12'
2 - 2½ x 6 - 11'-4 " 15'
2 - 4 x 6 - 11'-3 " 12'
2 - 2½ x 6 - 10'-5" " 14'
2 - 2½ x 6 - 10'-4 " 14
2 - 4 x 16 - 23' yellow pine sills
4 - 4 x 16 - 23-8 " " "
4 - 6 x 6 - 8'-10 " " from 2-28'
4 - 8 x 8 - 12'- " " 4-8x8-12'
600 sq ft 1" hemlock underfloor
600 " " 1½" yellow pine floor
700 " " Hemlock for Roof
1000 " " Siding
4 clear Pine boards 14" - 12 ft long
2 " " 12" - 15'
Yellow pine 4"x8" & 7"x6" for hanger supports



1866

Colson-Ore Mining Co.

21 Ore boxes 3' × 4½' × 5' = 60 cubft = 5 tons constant
20 Salt-Acid-vatts 2½' × 3' × 4' = 20 " "
20 Solution-vatts 2½' × 3' × 7' = 50 " make 10
10 Precipitation vatts 3' × 4½' × 5' = 60 "
Ore Bins holds 5' × 15' × 9½' = 360 " 30 tons each of 12
Water-tank 12' × 12' × 8' = at least 1000 cubft. constant.

Daily consume:
20 × 20 cubft. = 400 cubft water for Salt-Vatts
500 " " for Ore box washing
" " for diluting & washing
" " for Steam generator

2000 cubft. of Water to be lifted 40' high in Miners
300 Tons to be lifted 25' — 12 "
1000 cubft of Water at 60° to be heated to 212 degrees
1 Tons Coal daily consume or 2 cords of wood
Elevator to lift 8 tons in 2 min. 24 ft. high
with less than 10 H. P. —
150 Tons ore p. cart endless elevator.
13,440 ft-lb. per min. = full ¼ Horse power
2000 cubft Water 100' =
83.333 ft-lb. per min. = full 2½ Horse power

9000 cub ft. Water = 125000 ℔ × 40'
720 Tons ore 24' high = 268.800 ℔ × 24'
8 Tons ore p. Car 24' high in 2 min. = 6½ H. P.
Pumping Water & Ores = 3½ " " $1000
Total — 10 H. P. Engine

Total consume per day (10 hours) = 500 ℔ coal. or 2½
5.000.000 ft. ℔ for Water lift = 37 H. P. p. h. = 90 ℔ "
6.751.200 " " for Ore lift = ℔ " " = 120 ℔ "
8,60 0000 for Pump lift = 5 " " = 150 ℔
Pumps & Ores 360
140
Total for power — 500 ℔ coal
62500 ℔ day 100 000 ℔ Water to 212 = 2000 ℔ coal
2500 ℔ coal

Daily consume of coal 1 ton coal or 2 cords wood

1 Boiler for 250 ℔ coal per hour — for Wood —
= 28 ℔ sq. ft. grate = 5 ℔ ft. deep × 4 ℔ ft. wood
50 ℔ coal to Engine per hour = 50 ℔ ft. wood
1 Boiler for 10 H. P. Engine for 50 ℔ ft. wood per hour
= 28" diam shell 24 ft. wide 3' long grate
22=3" tubes - 5 ft. long. 13" diam stack
Wire ropes (1¼" circumference 3/8" diam (one ½")
Steam pump No 3 - 2" suction - 1½" discharge
¾" steam pipe 1" exhaust pipe. —

One mile track. 16# rail 25 tons at $60 = $1500

Number of ties 1760 yds = at 52 each $ 840

Splices — $ 160

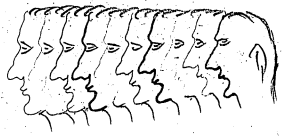
Spikes 3520 — $ 12

Total per mile for Iron & Wood = $ 2550

Rail track for inside of Mill and two outside incline tracks = 600 yards rail $ 3200

Water Barrels 10 & Pumps — $ 5000

Wirerope 1200 ft. for car hawling 1" diam. 120 keeves —



Now is the winter

Menlo Park Notebook #25 [N-79-04-03]

This notebook covers the period April 1879-April 1880. Most of the entries are by Francis Upton and John W. Lawson. There are also entries by Edison, Charles Batchelor, and Francis Jehl. Most of the material relates to experiments on electric meters. Other material includes drawings of lamps and regulators; calculations and drawings of generators and motors; calculations for electric power distribution systems, and notes by Batchelor on things to be done. The label on the front cover is marked "Meter Experiments." The book contains 282 numbered pages.

Blank pages not filmed: 22-23, 44-45, 78-81, 126-127, 164-165.

Missing page numbers: 181-182, 274-277, 279-280, 283-284.

254

Detroit Cu. / Weber
page 191, 251, 253

60

4

152
772
304
1064
1064
17344

Write Johnson about ferrule
of P. Bomber

Pages 1 to 25. "Motor Meter Sketches."

'. 25'

ster.

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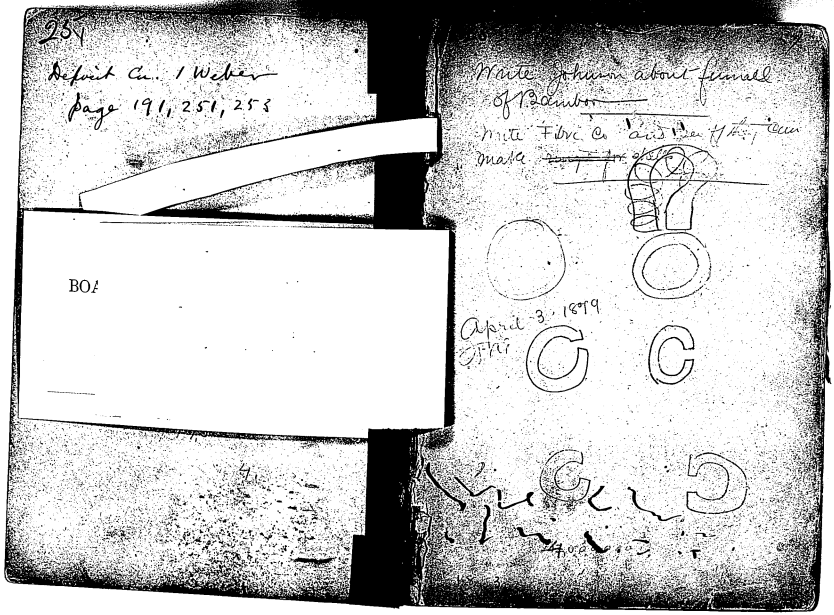
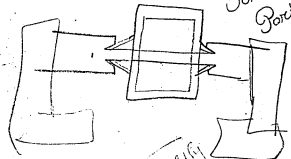

254
Defiant Co. / Weber
Page 191, 251, 258
BO
Write Johnson about funnel
of Pedmon
Write Fibre Co. and see if they
made
April 3, 1899

39.
40.

Portchester
Portchester



Fortnightly
Fortnightly
Fortnightly
Forwarded
Immediately

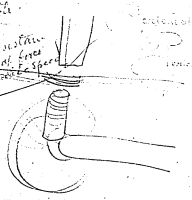
Fortnightly Fortnightly

9 fortnightly

Portland

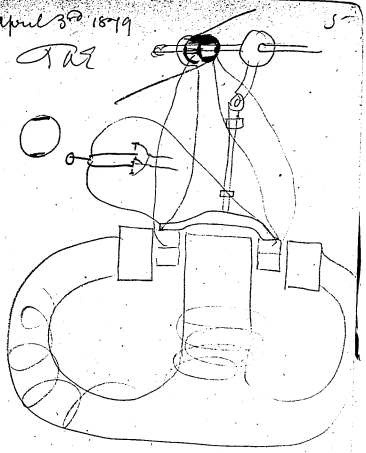
April 3rd 1879
TAP

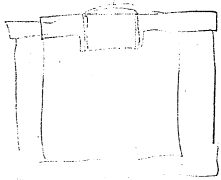
Strongest fixed possible
Concentric Circles
Normal magnetic Resistance
Cut all the lines of force
Highest practicable



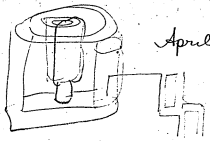
April 3rd 1879

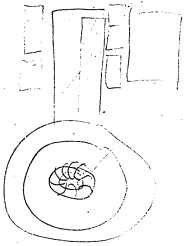
5





April 3rd 1879
Gas





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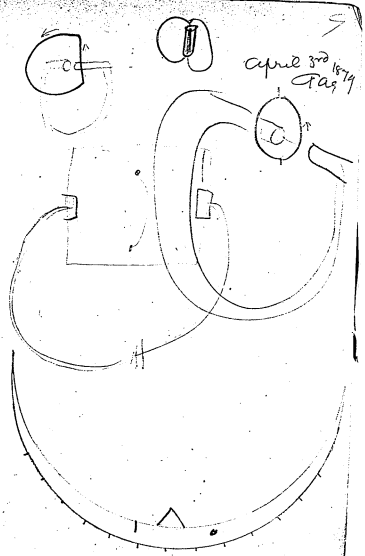

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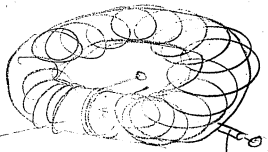
April 3rd 1879
T.H.R



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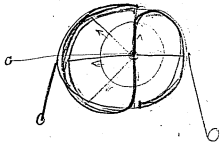
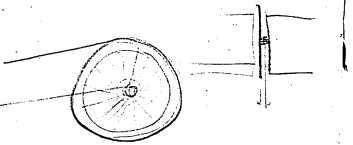
T.H.R





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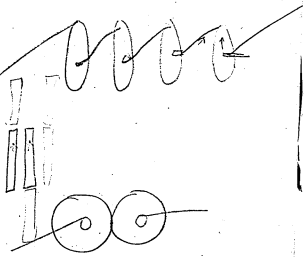
April 3rd 1879



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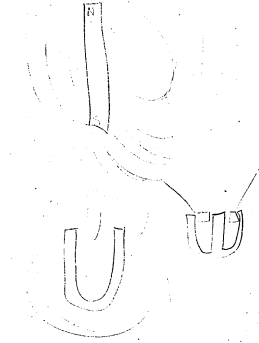

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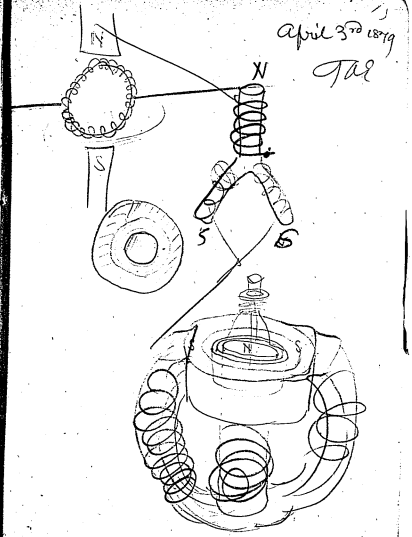

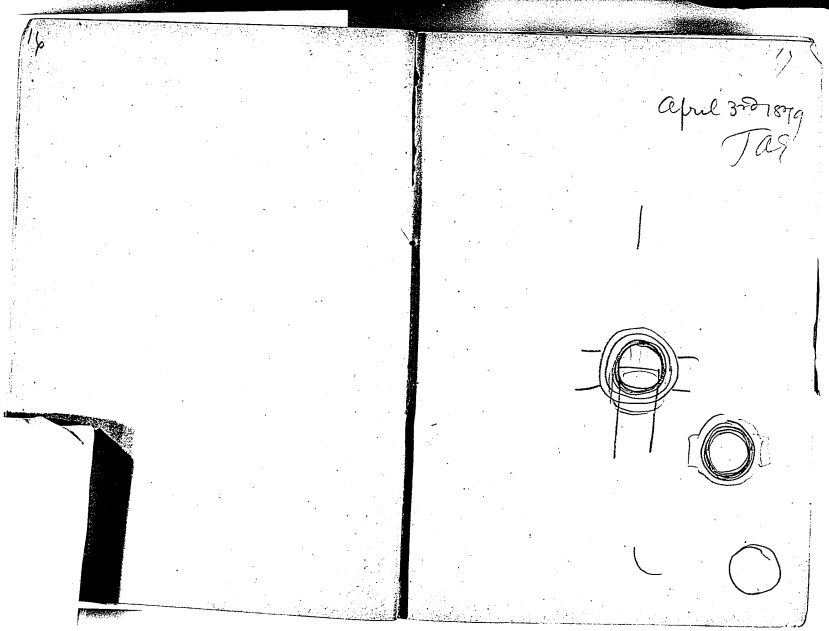
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JAS

In goes to @ 7
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from @ 3 to 5
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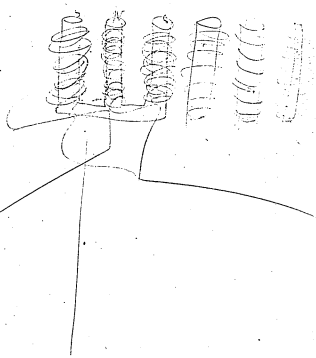
9 a.m



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April 3rd 1879

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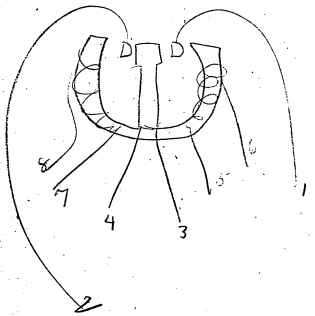

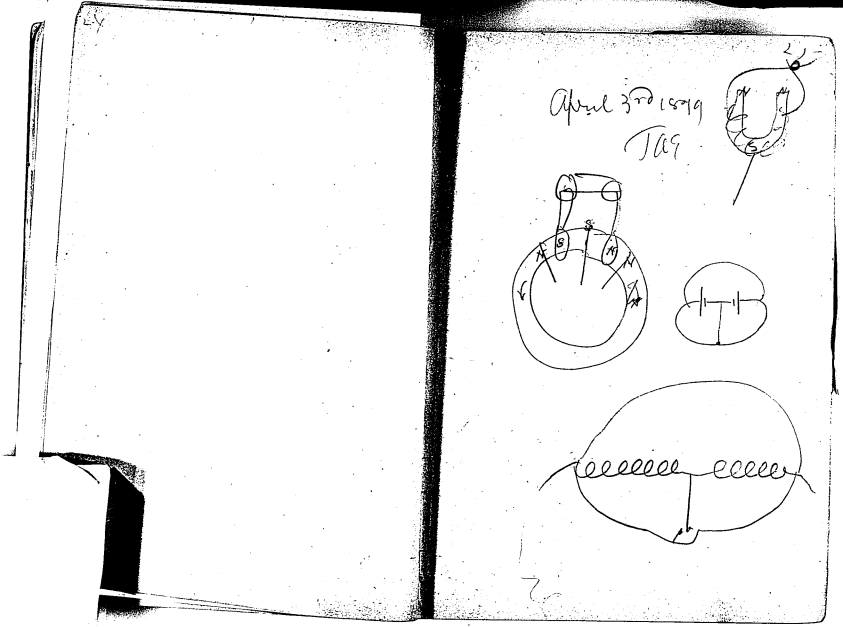

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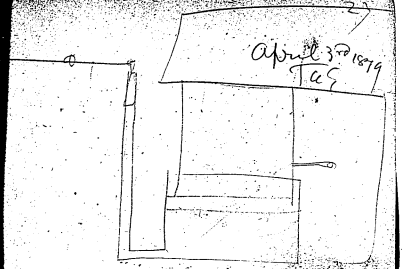

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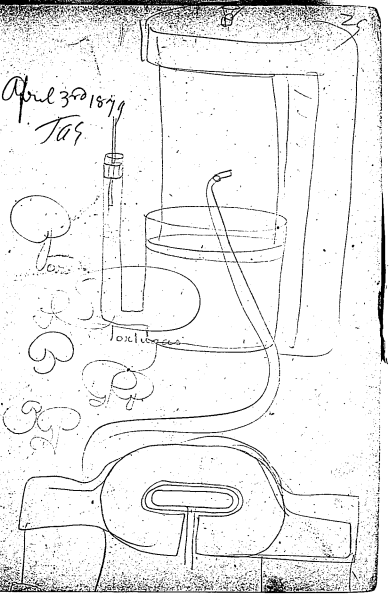

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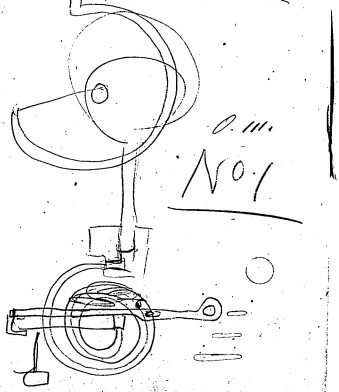

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April 4 1879

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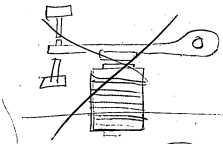

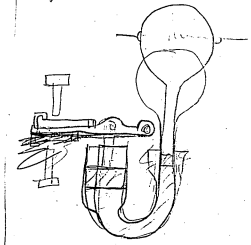

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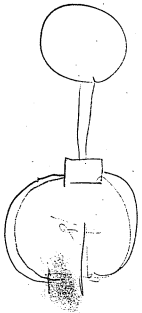
35

April 4
1879
B.H.S 113 Tuc9



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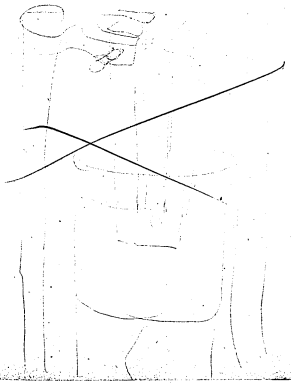

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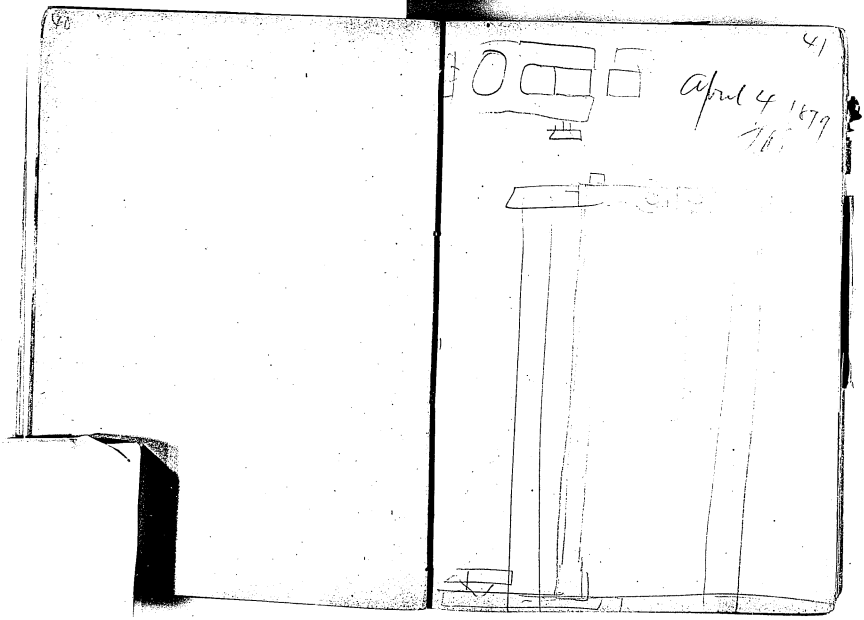
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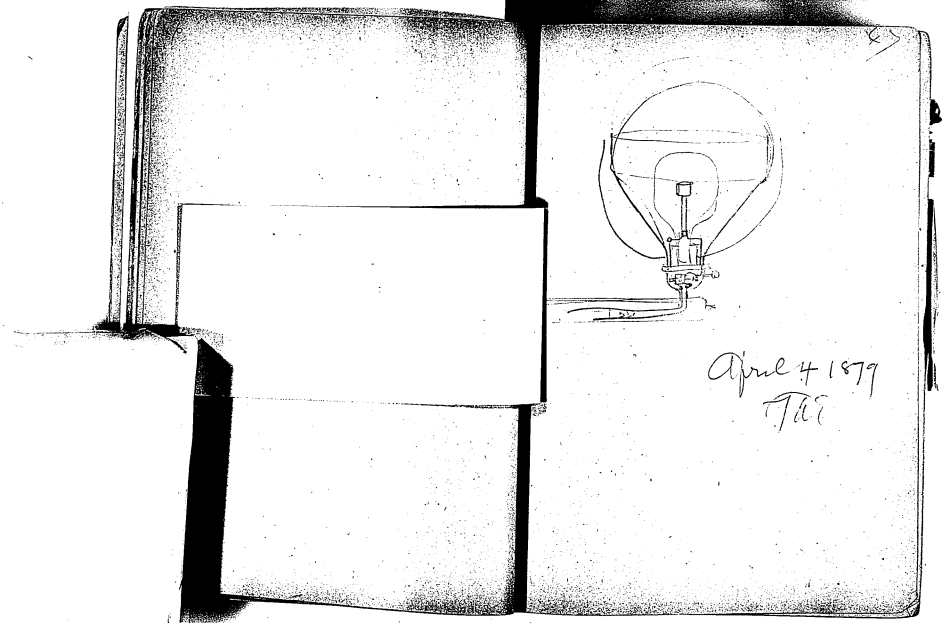
April 4 1679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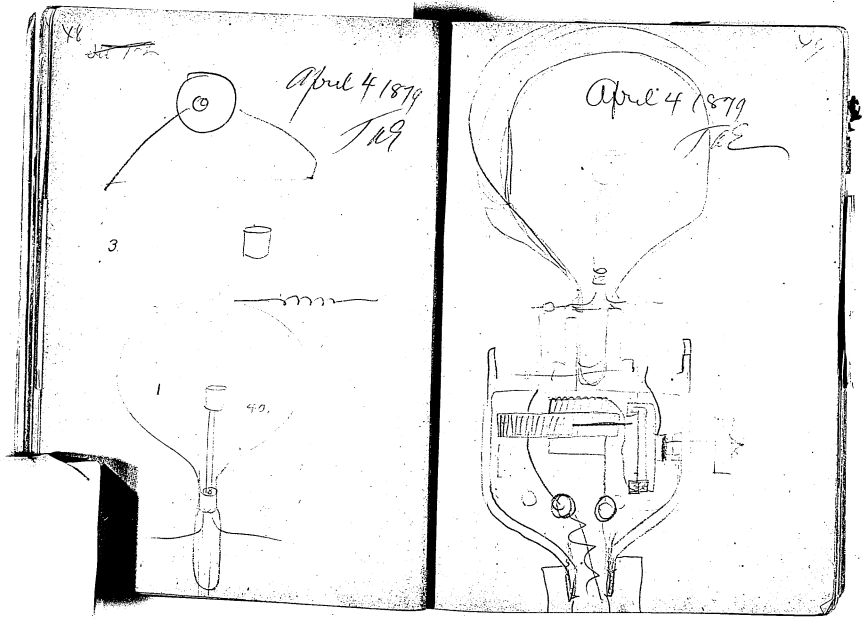
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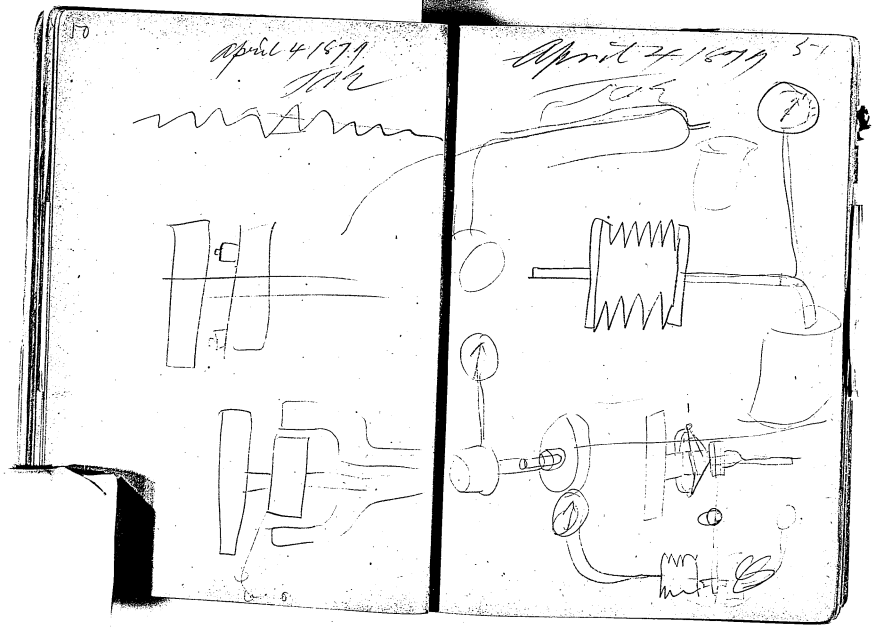
April 4 1879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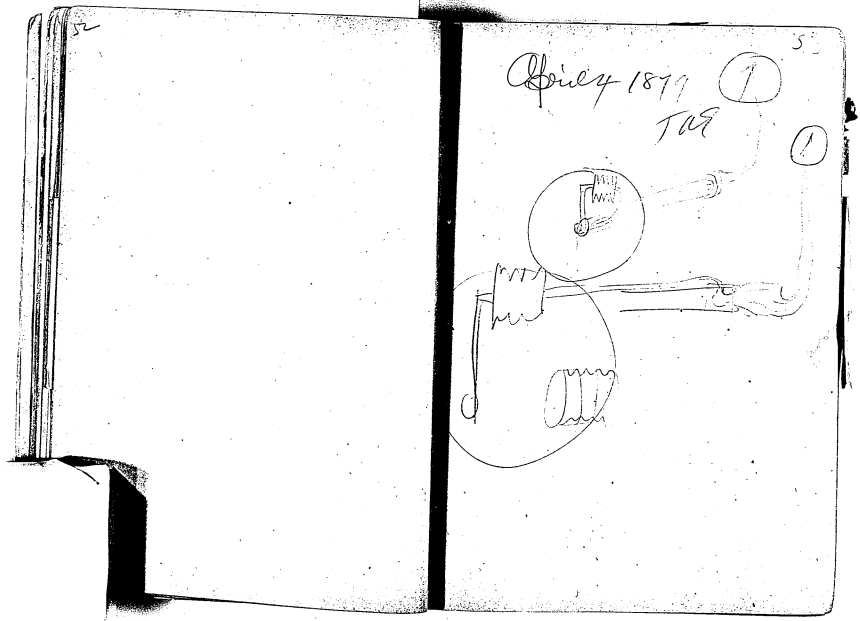
April 4 1679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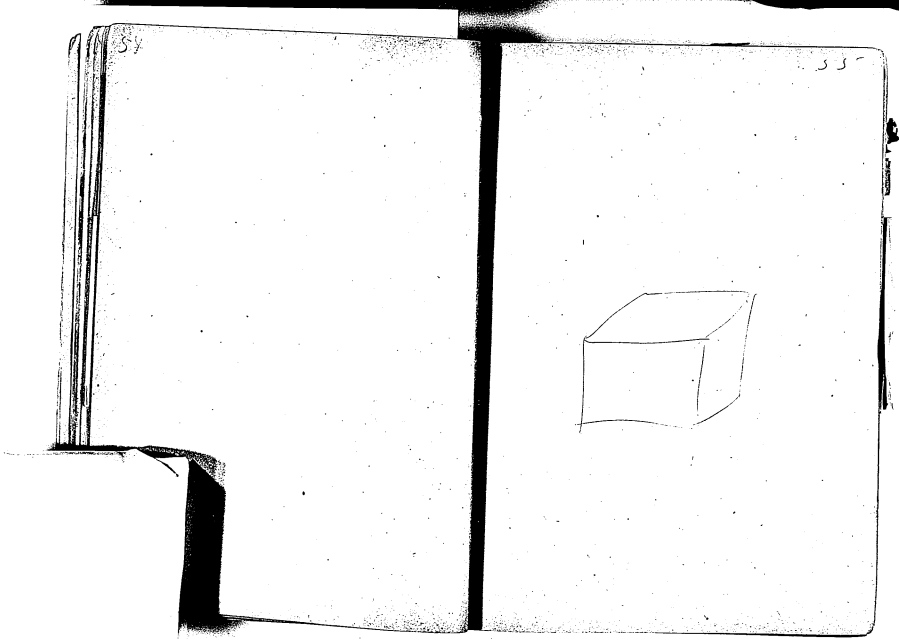
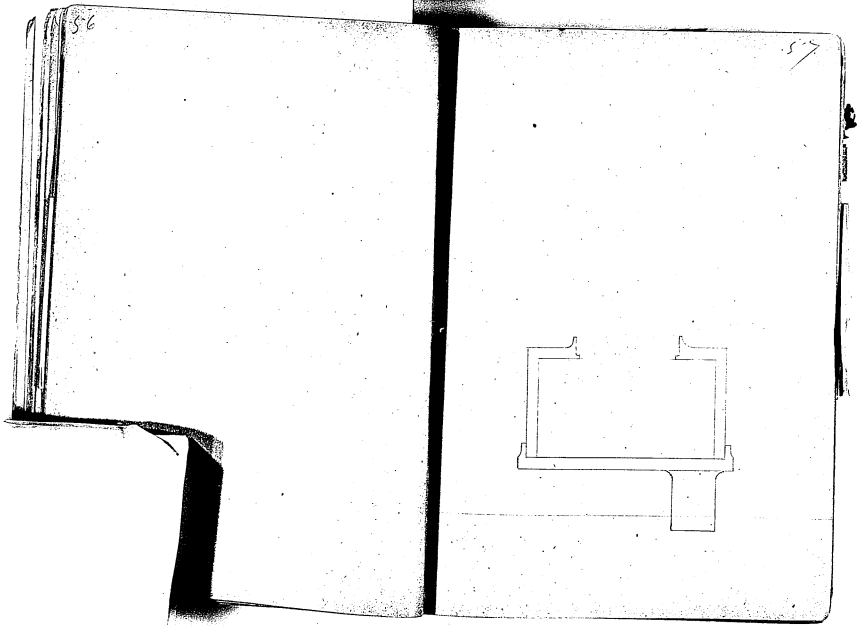
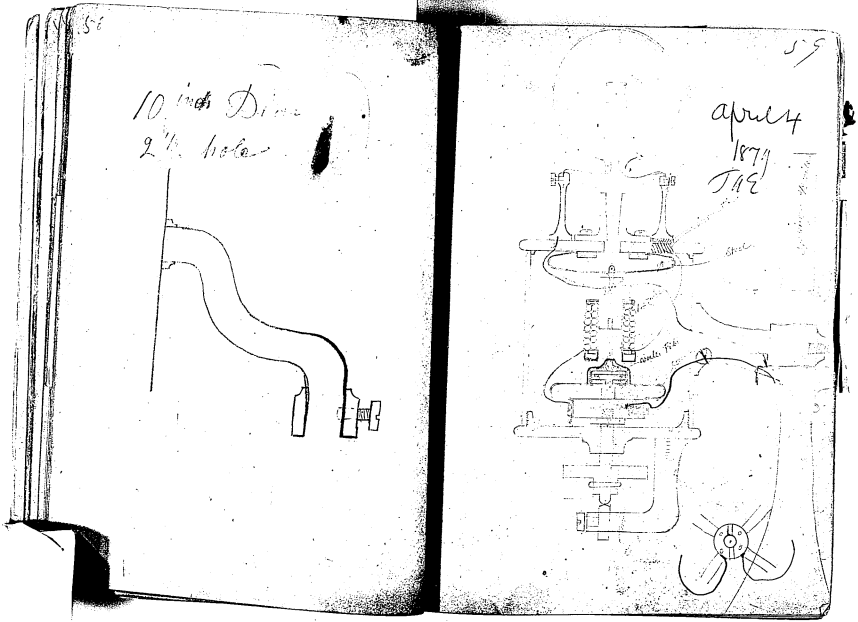




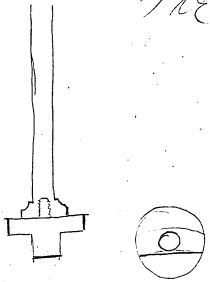

10 inch Disc
2½ Hole
55
April
1879
J.H.E

60

E1

April 4 1879

TLE



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E3

apriey
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270
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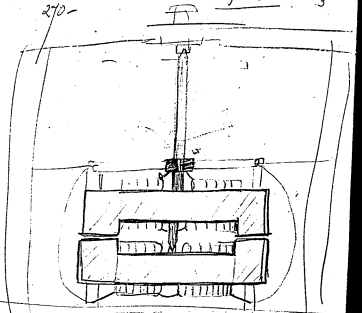

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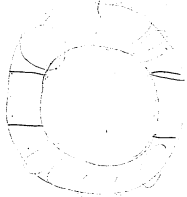
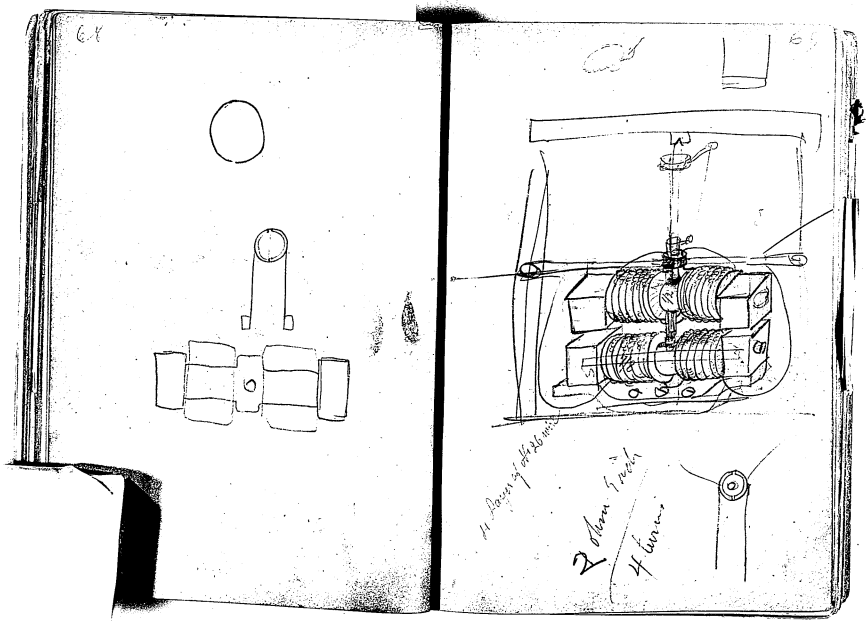
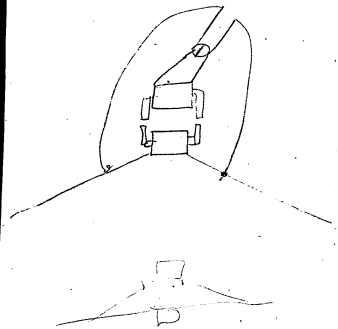
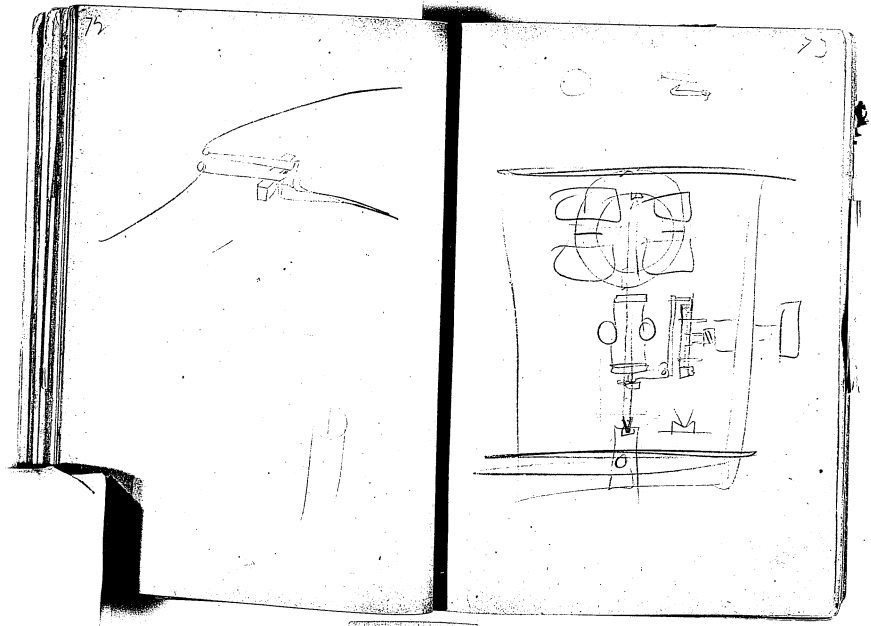








Two Daniels' cells through 10 Ohms with 4 voltameters in circuit each voltameter consisting of 250 c.c. Cu$(NH_4)_2(SO_4)_2$ and 2 Cu plates each exposing a surface of 8 sq. in. to the action of the solution each having one smooth side and 1 rough side it was found that the smooth side of the positive electrode was affected to such a degree that a thin section of the Cu gradually scaled off and was removed mechanically by the action of the solution

[ITEM FOUND IN BOOK]

on Cu
of the action of $CuSO_4$
alone extends. Through
too short a space of time
to allow of its being used
with any practical results

Add to a solution of
cupric sulphate a small
quantity of iron cork.

when it was placed as in the fig.

that it was called on in crude ammonia that the surface became covered with a film of finely divided Cu which by the action of the solution was removed when it was placed as in the fig.

[ITEM FOUND IN BOOK]

in solution 73 hours

Loss for 7 — 3 s-
" 8 — 26
" 9 — 18
" 10 — 30
" 11 — 19
" 12 — 16
" 13 — 24
" 14 — 18
" 15 — 11.5

Wg. 26.563/8
22.426 1/3

$\frac{7}{8} - \frac{1}{3}$ $\frac{21}{24}$ $\frac{8}{24}$ $\frac{13}{21}$

$\frac{13}{24}$

4.137 13/24

[ITEM FOUND IN BOOK]

10.3449

200 cc $CaSO_4$
+ 2 cc H_2SO_4
Sp gr = 1.21
at 30°C

35°, 26, 18 } 7-9
35°, 25°, 17

30, 19, 16 } 10-12
30, 20, 13

24, 18, 11.5° } 13-15°
24, 16, 10.7

29

9.8182

13-6 Run
200 cc $CaSO_4$
2 cc H_2SO_4

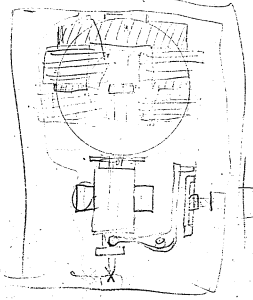
7	9	35°
10	6	30
"	3	19

9	35°
4.5°	23.3
2.25	15.5°
1.5°	16

28

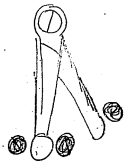
Regulators

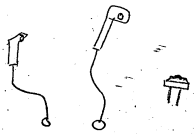
May 11th 1949

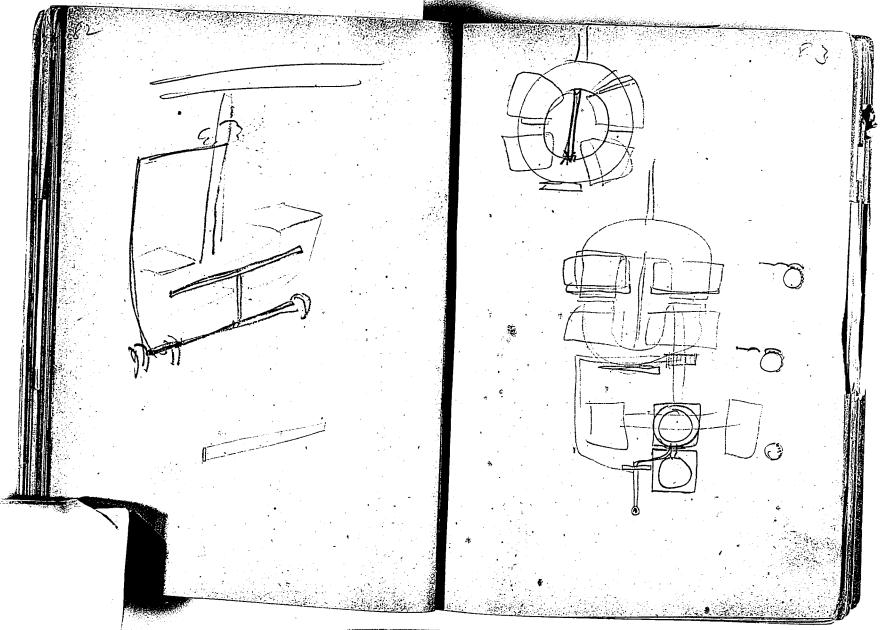


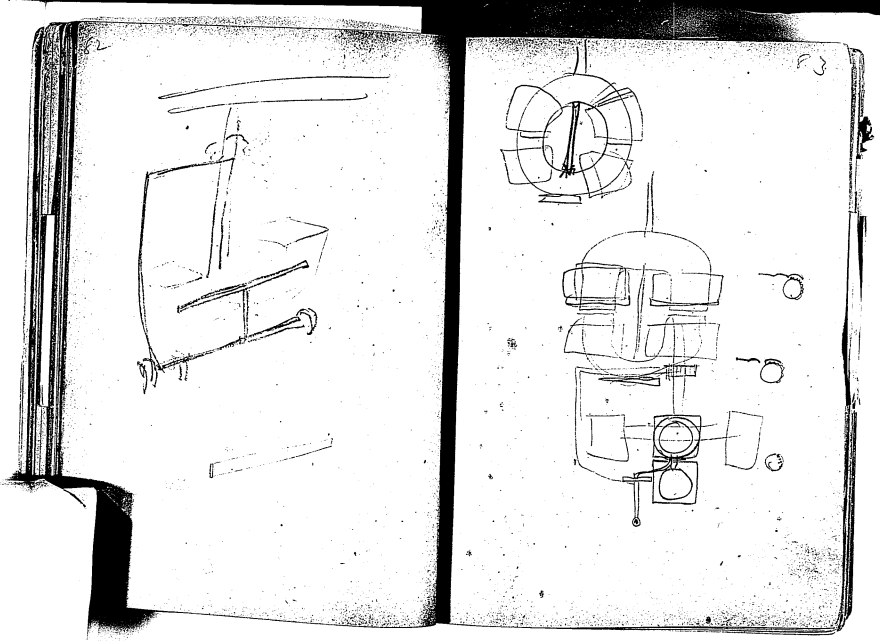
.04 in each direction

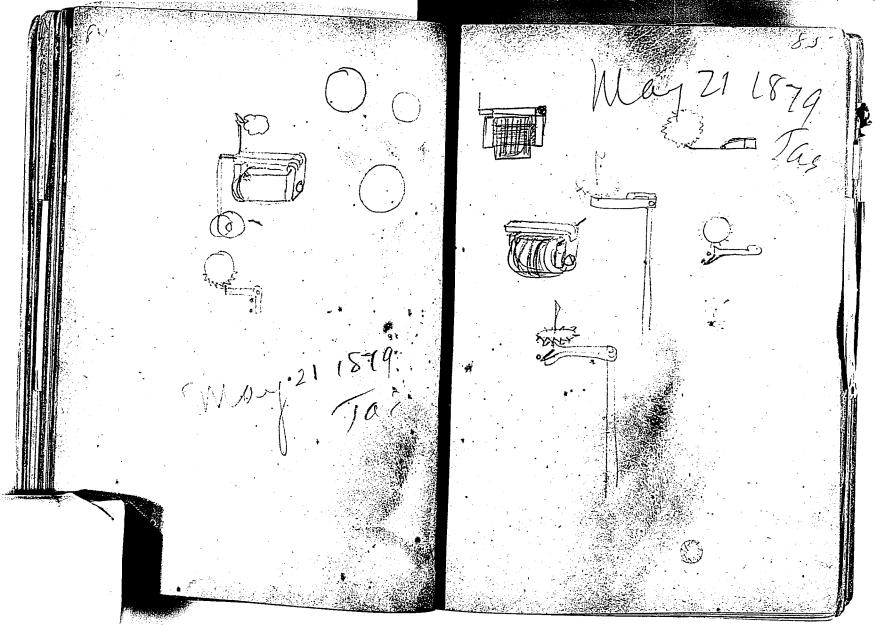
Sketch made drawing

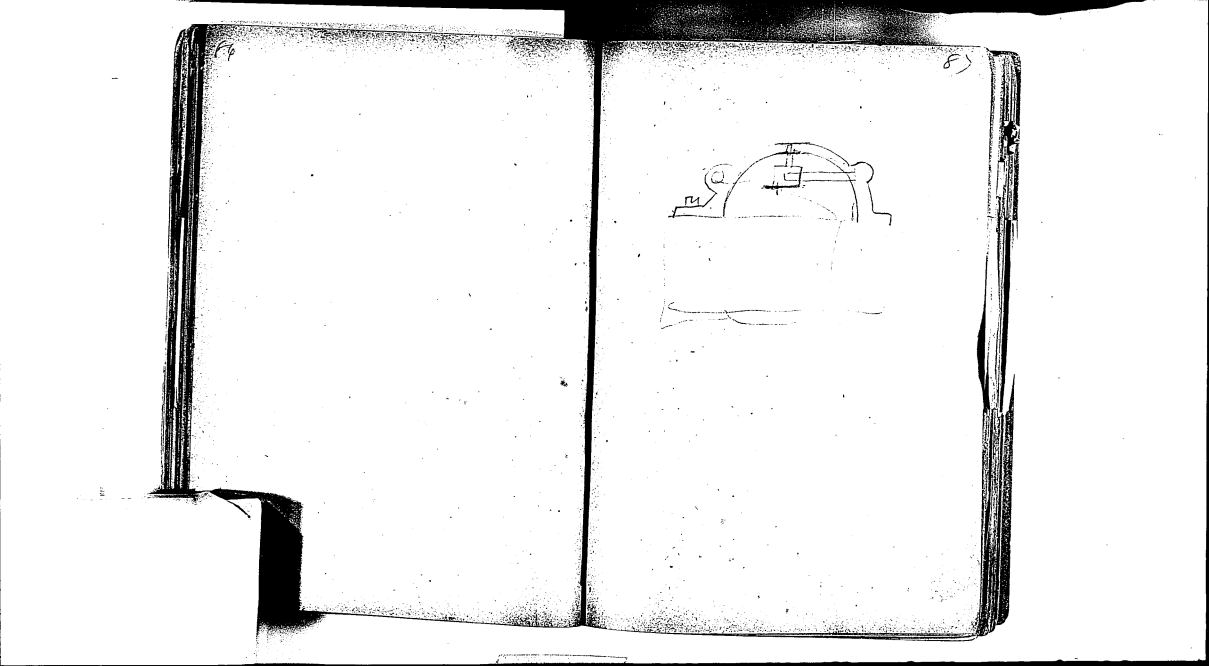


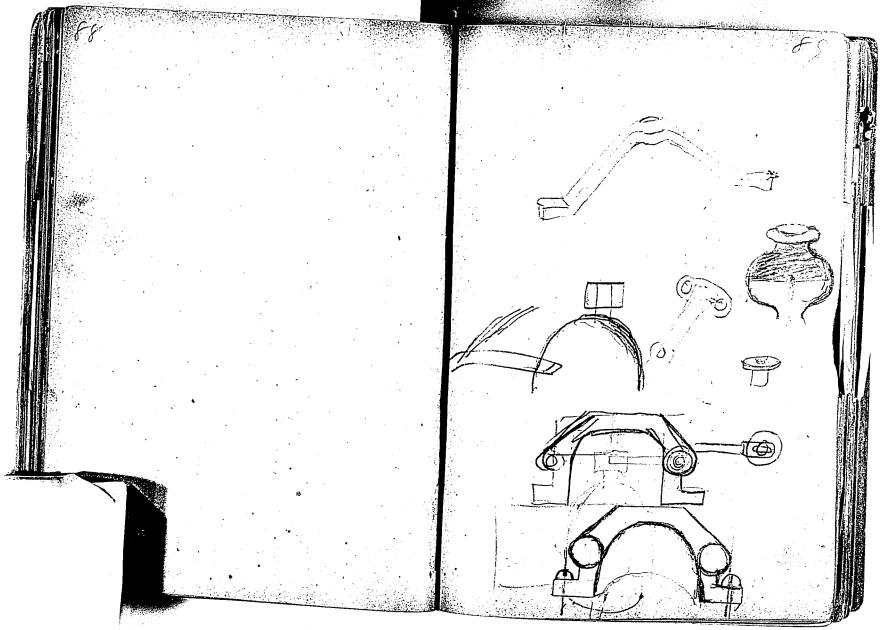


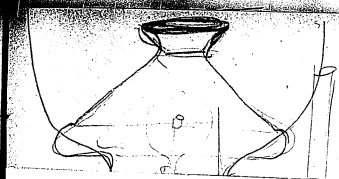





May 21 1879
Jas
May 21 1879
Jas





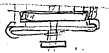


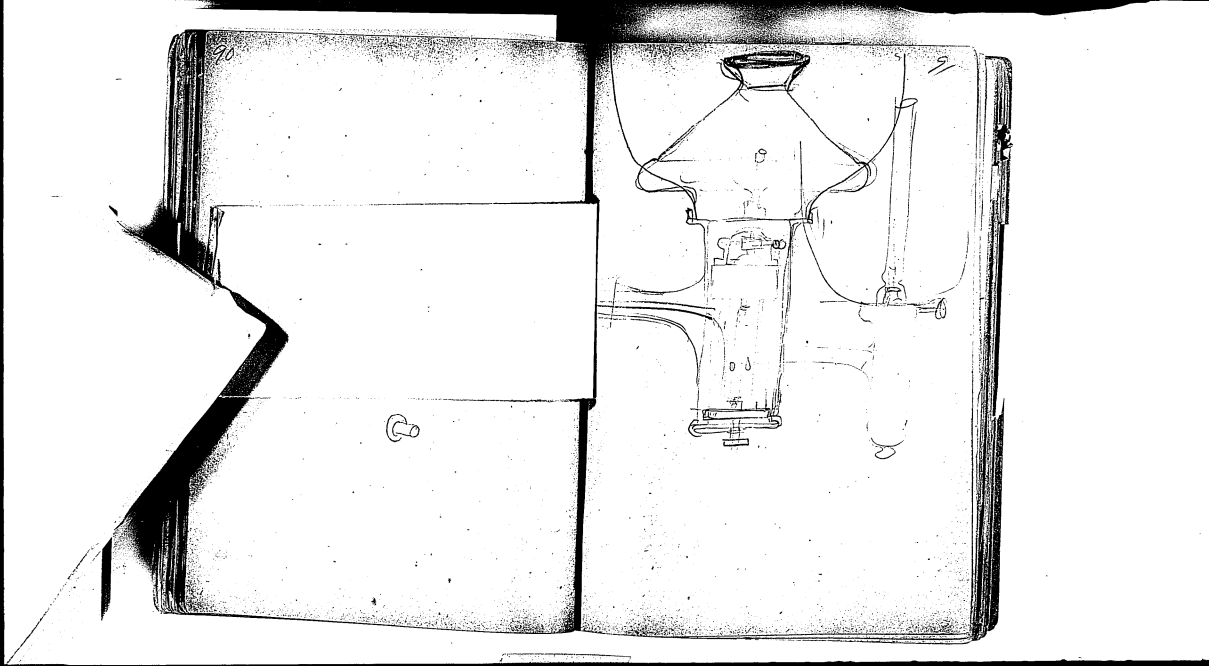
Edison Laboratory Note Book No. 25.

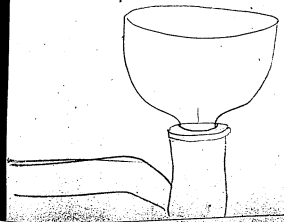
Pages 91 to 93.

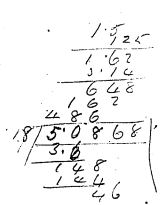
Incandescent Electric Light.

See Edison Patents:
314,636
314,637
318,636
327,327
327,328

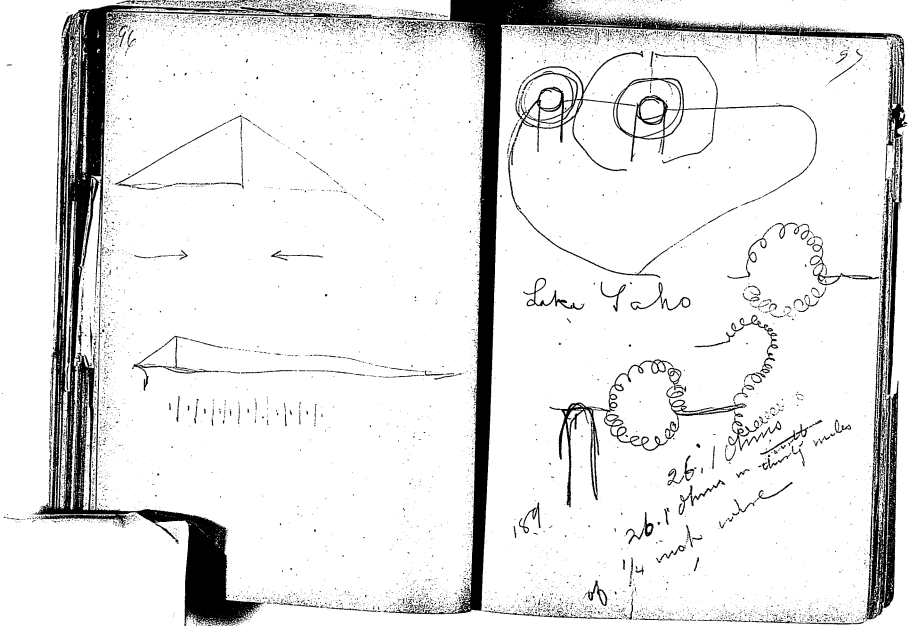








283
2
25


96
95
Lake Tahoe
26.1 Ohms
26.1 ohms in slightly moist
1/4 moist
1871

98

159
3vo
1859
1858

20

$7.509 for conductor

26.1 Ohms

10 machines 1000 volts

2000
1000
$1000 for a H.P. machine

day five H.P

2¢ a H.P.

99

20 a gear a H.P for machine

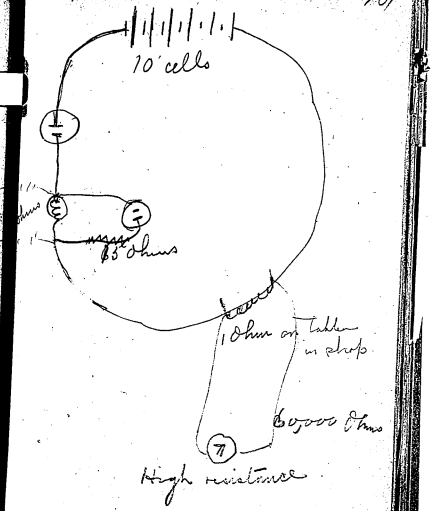
365)20 $\frac{20}{36.5} = \frac{100}{18.7}$

~~2 cts a day for interest~~
~~per H.P~~

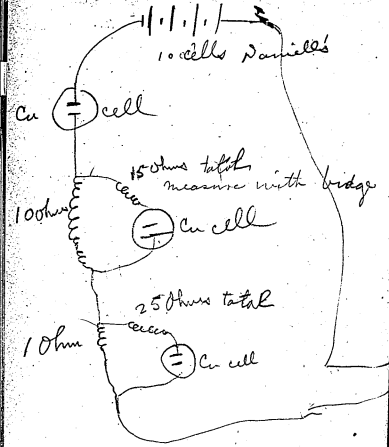
5 cts, a day for interest
per H.P.

0
0

Cord of wood $12

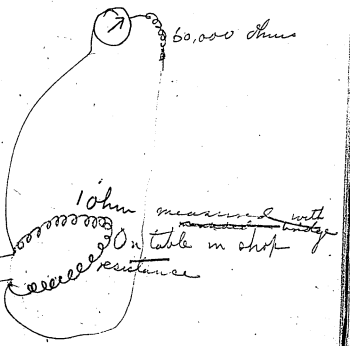

10 cells
T
E
G
63 Ohms
1 Ohm on ladder
in shop
Bobbin Ohms
H
High resistance

102 Meter Exs.



Meter Exs. 103

100 = Deflection one Daniells
circuits of high resistance closed
on itself.



Copper No

1

50 ✓
10 ✓
2 ✓
.500 ✓
.200 ✓
.100 ✓
.50 ✓
.20 ✓
.025 ✓ OK

62. 272.5
63. 27[illegible].5

No 8

50 ✓
5 ✓
2 ✓
.200 ✓
.50 ✓
.20 ✓
.10 ✓
6 1/3 ✓

57.2261/3

Copper No 2

50 ✓
5 ✓
1 ✓
.500 ✓
.100 ✓
.20 ✓
.10 ✓
1.5 ✓

56.6435
770.640

50 ✓
5 ✓
1 ✓
.100 ✓
.50 ✓
.20 ✓
1.75 ✓

56.17175
56.574.25

63.27486
62.87025
.4060

57.475
171.075
.40300

57.060
56.6475
.4125
.4060
.4030

1.2215
.4071 Grammes
407.1 Milligs

18° to Three

1 Standard Daniells 200 = Ω

R = 123

$R \frac{567}{100} - \frac{5}{100} = \frac{562}{100} = 5.62$ ohms R

44/128
.615 Daniells
5.62 ohm

.615
5.62

T. 7889
0.7497
T. 0392

.1095 Daniells on one Ohm

106

60 ⟌ 40.7.1 Mlly in one hour
6.785 Mlly in one minute

Comp. 1.095 .9608
Log 6.785 .8315
1.7923

62. Mllgr in one minute from one ~~Ohm~~ Daniells of current! on one Ohm!

62. 1.7923
comps 1.079 9.9670 −10
1.7593

.574 Mllgr one Weber.

Over [illegible]
1.7593
973 1.9861
1.7454
559
[illegible] on authority of Rosa & Dorsey

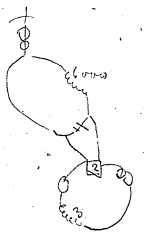
107

60 ⟌ 62
1.03 Mllgr.

103 71/200 < .355
103
1065
.355
.365 Mllgr to from one Daniells cell one

108

77
.385
1.03
11 55
385
39655



109

No 2 56.6594
56.6585 ←
+ .0355 gm

No 4 56.7385 No 6 57.467 ←
No 6 57.467. 57.4547 ←
= .0023 lm
No 2 56.6585 e.p. 56.776
56.7385
+ .0375 gm

I.S.D. Def. 200.

S/ 106.

I.S.D. Def 200. a current passed for a short time through the platinum and measurements

110

Weight of Cuttlates

No 2 56.694

No 6 = 57.4549/4

No 4 56.776

The plates put in solution

No. 2 put in pure solution of Cu

No. 6

No. 4 put in commercial Cu.

July 2 Ft. Meter Experiments

No 2. put in C.P. SO_4 Cu. Lost 4.25 mgr

No 6 Commercial Cu Lost 4.25.

No 4. " " " 2. mgr

Added ammonia to the solutions and filtered.

Plates immersed 2 hours

No 2 in C.P. SO_4 Cu 3.25 — RAM.

No. 4 in commercial 6. P.M.

6. A.M.

No. 6 " "

No 6. Lost 1.5 mg after longer

No 2 " 18.75 mgs. " "

July 24

No 6. 56.832

No 7 53.253.5

---

700 Volts $\frac{100^2}{100} = 100$

100 Ohms

---

150 Ohms

X Volts

$\frac{X^2}{150} = 100$

$X^2 = 15,000$ | 4.1761 / 2.0880

122 Volts

34
34
34
34

33
33 1/2
33 1/2
33 1/2

.034
.033 1/2
.033 1/2
.034

33 1/2

34
34
33
33
4)134
93
3

Cu. wire
186.5 Ohms 200 feet

0.0335" = diam

July 29 1879

Having deposited copper on copper foil, set the three in operation.

No 1 weight 27.464 was put in a Solution of Sulphate of copper (Commercial) at 4 o'clock P.M.

No 2 was also put in a sol: ution of Sulphate of copper. Com in which there was a little ammonia added, at 6 P.M.

No 3 was put in a C.P. Solution of Sulphate of copper at 8 P.M.

15

15 Volts

Lamp 1 Ohm
1.5 Ohm inter
2.5

15
15
75
15
225
4
900

44.3
9
3547
3547
5 | 7094
1419

1 Ohm
1 Ohm

| 225
11.25
44.3

20511
1.6464
3.6975

| 4983
2491

3.6975
3.6975
.8210

20 ohm
1

3 | 225
75
44.3

1.87851
1.6468
3.5215

| 3323
1107
2216

20

4 | 225
56.25

1.7423
1.6464
3.3887

2448
612
.1836

8 | 33000
4125
5
20625
772

4.3144
2.8876
1.4268

26.7

12

.30
.06
.11

1/10 1/10000 100

1/4 100 200 20000

1/4 1/16 2 1/2 Ohm

1/2 Ohm

1/2 1/2

4430

6 | 33000

1 | 5500 3, 7400

16 1.

| 5500

| 1375

344

8

.8 64 1.80.62

1.6 1.6 0.2041

1.6021

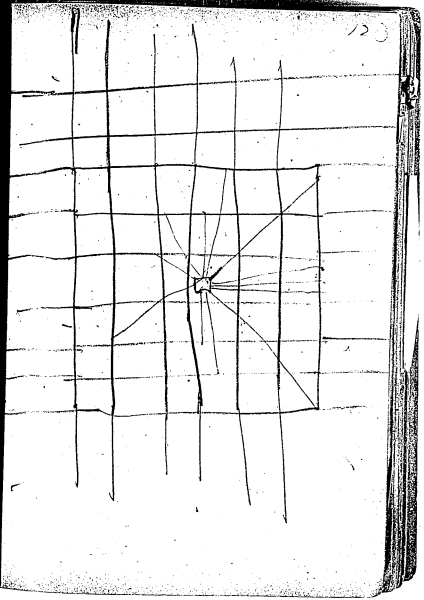
44.3 1.64.64

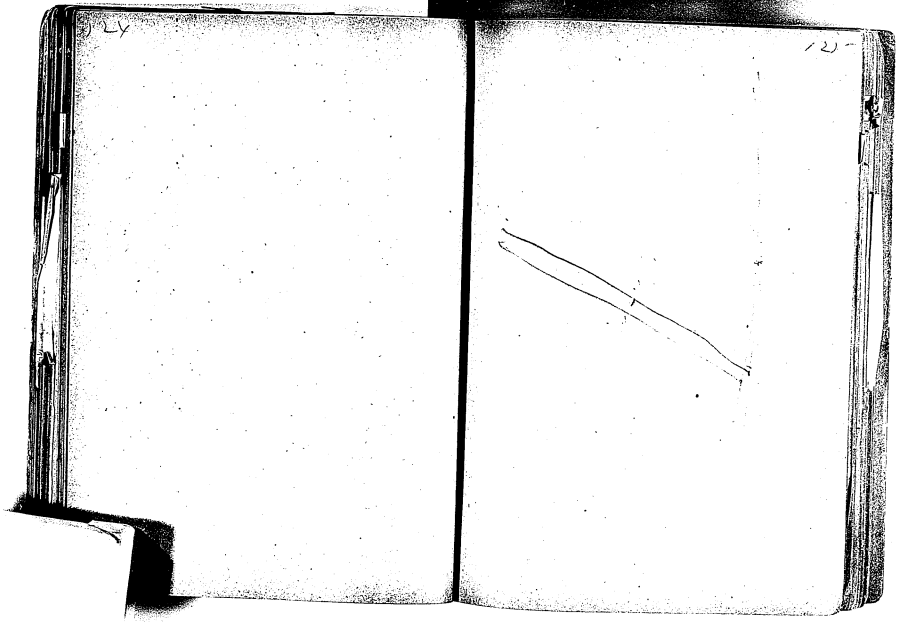
3.2485

| 1770.

885

442





1 inch

2 candles 800 ft. lbs

2000 foot lbs

75
.75
355
52 5
5305
2802

2802
443

3.4475
$\frac{1}{2}$.6464
5.0939

124 000

5.0939
$\frac{1}{2}$.5155
.5754

3.76 H.P.

75
3 0.
1.00
1.33
.9
2.23

2.23

83
83
comp 2.23
log 44.3

137000

61.400

1.9194
1.9194
9.6617
1.6464
5.1369
9.6617
4.7886

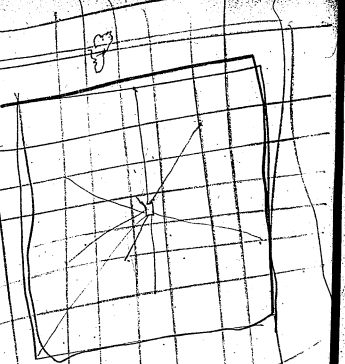
175
5
317.5
1.25
1.25

142000

6.6.100

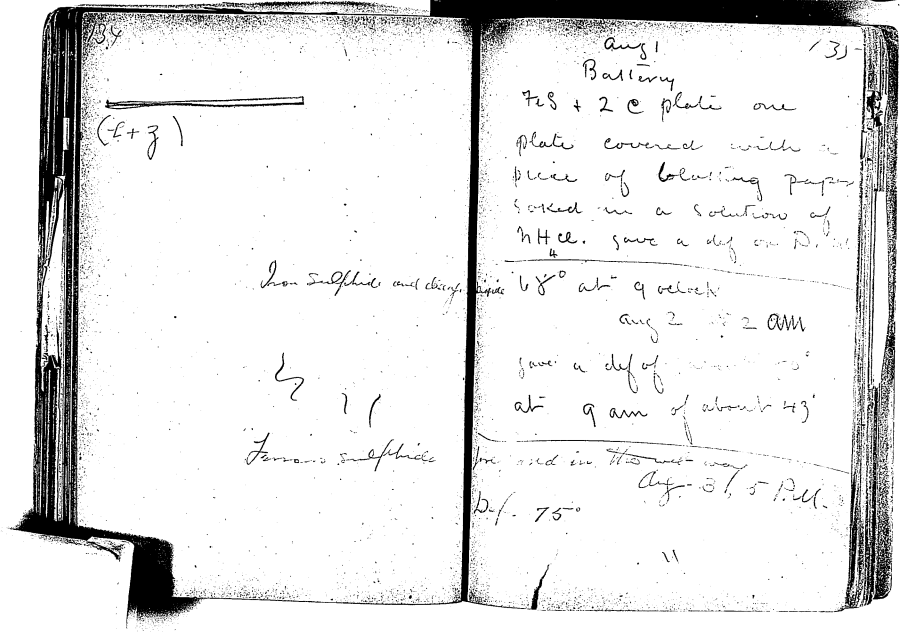
83 1.9194
83 1.9194
2.15 9.6676 -10
44.3 1.6464
5.1528
9.6676
4.4804

5,1528



Angle 45°39' 90°

Equilibrant



(f+g)

Iron Sulphide and charcoal

Ferrous Sulphide

Aug 1
Battery
7 Zn + 2 Cu plates are
Plate covered with a
piece of Coloured Paper
Soaked in a Solution of
NH_4Cl. gave a def on D.C.

Aug 2 at 9 o'clock
gave a def of
at 9 am of about 45°

Aug. 3, 5 P.M.
Def. 75°

11

aug 4. 1875 43

2 Cholorride of Silver Battery

Measured the internal resistance; found it to be about eight ohms, it gave a deflection on the tangent of $1\frac{1}{2}°$ which = $\frac{1}{8}$ of an ampere. put it on short circuit also might, gave a deg of 58, in the morning aug 5 it gave a deflection of 48°. after this obs fell to about 15°. Dg

I also measured the Electro motive force, which = about .9 of a daniell

Aug 6 1879

Test of Latimer Clark battery. Constructed the battery as follows. In five small jars I put in about one quarter of an inch of mercury (Hg) on top of this I put a paste made of Mercurous Sulphate (Hg_2SO_4) and [illegible] of Zinc. ($Zn SO_4$). four of the batteries contained the Mercurous Sulphate made by dissolving the mercury in nitric acid and then precipitating. The Mercurous nitrate $Hg_2(NO_3)_2$ with Sulphuric acid.

---

one contained the Mercurous Sulphate (Hg_2SO_4) made by dissolving the Mercury (Hg) in Sulphuric acid

---

V. 60° F. = (1.2/3 C)

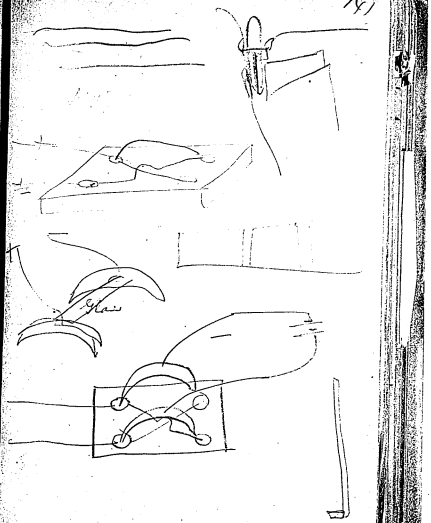
Elements			
No. I.	Internal R.	V. ohms
* " II.	"	"	13. "
" III.	"	"	4.7 "
" IV	"	"	5.3 "
" V	"	"	5.7 "

* This Element contained the Mercurous sulphate made by the Sulphuric process.

	Stanley	144	
No. 1	Daniells	150 L	153 R
No. 2		150	
3		150	
4		150	
5		150	

(No 2 50 4)

No. 1	181 L	185 R 186
No 2	Sulphuric acid 188 L	193
No. 2 against	Standard Daniell	35 R
No 3	187 L	192 R
No 4	182.5 L	189 R
No 5	184 L	189 R



42

15.5 C

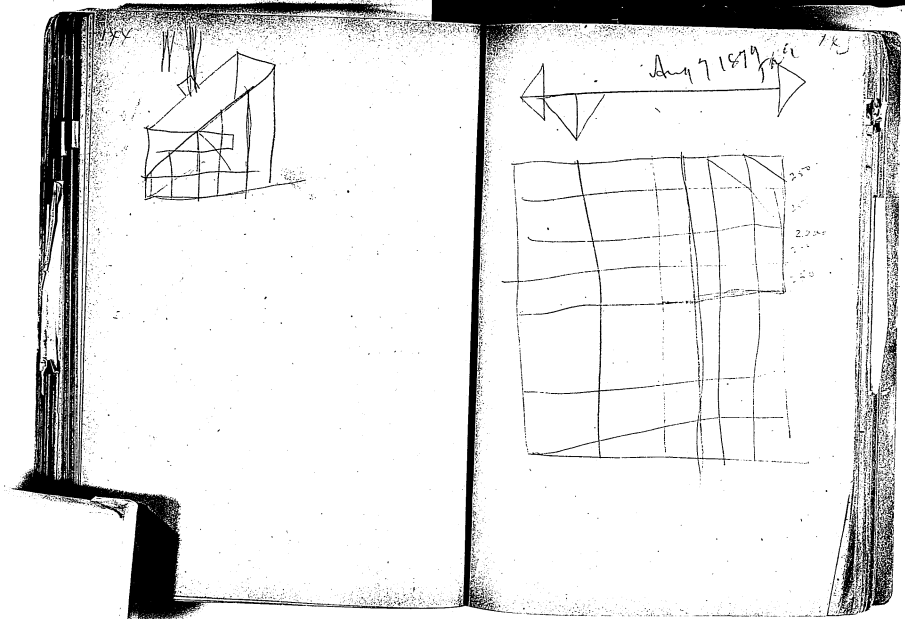
.055

.088

Test of Latimer Clark 143
battery and remarks on same

Test of Clog Battery
Aug. 4

gave an internal resistance of 13 ohms. and an electro motive force of one Daniell's. put it on short circuit, gave a deflection 45°
at one o'clock it gave a deg. of 58° showing that it has average about the first three clocks it was at 57° at about half past four 45°, put her off + Clog Her remedy for a day when put on short circuit again she gave a deg of 25 went down to about 5° at 8 PM.



146 Test Aug 7

Test of $Fe_2S_3 + CaCl_2 + O_2$ Battery. Its electric motive compared with a Daniell, = .88 of a Daniell Internal Resistance of about two Hundred ohms

But here on short account at eleven oclock it gave a deflection of 42° at quarter to twelve it gave a def of 30° when I came back from Lunch it gave a def of 61° at Eight PM. 60° at about Tenandaq 9 it gave a def of 57

132. 120 66
150. 146

150 | 13200 (88 84/151 80/55 (5 1/3
1200
1200

60
150 | 8000 (53
750
250

774

147

1908 Aug 7 Yaffe Battery

Compare with the Daniell it equals to about .5 of a Daniell. Internal R. 6 ohms put her on short circuit at eight o'clock AM + gave a dip of 55°. At twenty 9 gave a dip of 45°

Aged. 149

Measured the whole set of 8 elements gave a internal R of .54 ohm Compare with the daniell they = to .48 stayed out the the morning after being on short circuit all night

Aug 10

Used Daniell battery
~~10 ohms~~ internal R
when first put up.
Its electromotive was
99.5 of a daniell, but it
~~N~~ short circuit.

Aug 13

Tested internal R gave R of
2.60 ohm.

82 Wallace

Wire No. 1. Sept 76

0.03 Ohm

49 feet 3 inches

.1341 in diameter

comp 49.25

134.1

134.1

10.95

10.68

97.6 annealed

9.94

99%

99.9%

Wire No. 2

.004

53 feet 4 inches

.1205

comp 53.66

120.5

120.5

comp 1.0994

9.84

99.9%

0.07 Ohm

57 ft 11 inches

72/110 9.16
198
20

.094

.07	$\bar{2}.8451$
comp 57.92	8.2371
94	1.9731
94	1.9731
	9.9586
	.9870
	9.70

0.12 Ohm

57 ft 11 in

.0725

.12	$\bar{1}.0792$
57.92	8.2371
125	1.8603
72.5	1.8603
	9.9586
	.9955

9.90

100%

S.P. per mile 76 ±

59 feet 4 in

0.19 ohms

.0575 inches

.19	$\bar{1}.2788$
circ 59.35	8.7738
57.5	2266
57.5	1.7597
	1.7597
	9.9586
	.9834
9.63	.9955
	9834
	10121

103% Feet in mile 5280

9.829

157

9.718
9.940
19.658
9.829
5.280

.2064
.2106
2 | 4170

9.829 | 0.99232085
.4170 | $\bar{1}$.6201

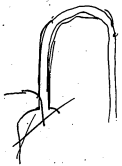
Gold Cu 1111 inches long weighs 1.3722

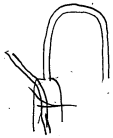
23.5 grains

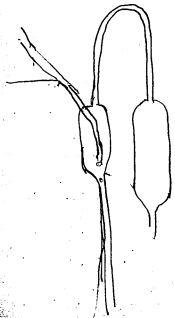
1.3722
3.5451
3.5271

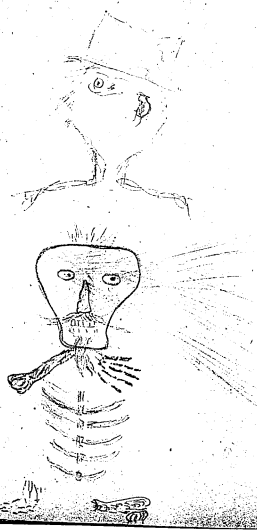
2000

Ohms per foot 3.5271









$5x - 6y + 4z = 15$

$7x + 4y - 3z = 19$

$2x + y + 6z = 46$

$12x + 6y + 36z = 276$

$17x + 40y = 291$

$8x + 4y + 24z = 184$

$x + 27z = 165$

$16x + 13z = 96$

432 / 13 / 419) 25244 (6
2514

27
16
162
27
432

165
16
990
165
2640

96
2584

$5x - 6y + 4z = 15$

$7x + 4y - 3z = 19$

$2x + y + 6z = 46$

$14x + 8y - 6z = 38$

$16x + 9y = 84$

$15x - 18y + 12z = 45$

$28x + 16y - 12z = 76$

$43x - 2y = 121$

$16x + 9y = 84$

$387x - 18y = 1089$

$32x + 18y = 168$

$419x = 1257$

$-2y = 121 - 129 = -8$

$y = 4 \quad z = 6$

$x = 3$

$419) 1257 (3$
-1257

Aug

Put two coppers no 8. (24.387½) and no 10 (28.368) and also no 9 (22.427½) and no 6 (29.001¼) in a solution of Sulphate of Copper, mixed with Rochelle salts dissolved in Caustic Soda

Aug 27

after leaving the coppers a few days in the above solution the results were as follows.

no 10 weight 28.352⅔, which is 15⅔ mg less, no 6. 28.998½ which is 2¾ less.

no 9 22.426¼ which is 1 1/6 mg less

no 8. 24.379¾ which is 7¾ mg less

Aug 29

Put the copper in the solution again with a

current of 2 volts. for
10 min. I had them
in until half past nine
the next morning. Took
them out & let them
dry, and had Killey
to weight them. the weights
were as follows,

No 6 ~~2 [illegible] 3.3~~ 33.123
before putting it in the
solution it weight 28.998
showing an increase in
weight of 4.124 4/6

No 10 24.469 8/8 before
putting it in the solution
it weight 28.352 2/3 showing
a decrease in in weight
of 3.887 13/24

No 9 26.563 1/8 before
putting it in the solution
it weight 22.426 1/3 showing
an increase of 4.137 13/24

No 8 20.392 before putting
it in the solution it weight
24.379 3/4 showing a
decrease of 7.987 3/4

Those which had a
decrease in weight had
on taking them out a
soapy surface yellowish
green, while those which
had an increase had
a dark brown color on
one side while on the
other side half way down
it had the same color the
other half being the bright copper color

Sept. 2. 1879

Put no 6 & 9 in a solution
cu & NH_4 of $Cu(NH_4)_2(SO_4)_2$
at noon. No 6 weight
$99.108\frac{1}{4}$ and no 9 weight
$26.545\frac{1}{3}$.

In one mile how much
weight of wire?

Strength.

Cu wire 189.07 lbs. in 1000 feet
has a resistance of 0.1654 Ohms

~~189.07~~

Mile 5.28 .7226
.1654 1.2185
1.9411

$R = \frac{L}{W}$

$.95 = \frac{L}{W}$ $WR = L$

189.07 2.2767
1.9411

165 2.2178
872. .7226
2.9404

172

$R = \frac{\rho}{S}$

$W = \rho S$

$S = \frac{W}{\rho}$

$R = \frac{\rho}{\frac{W}{\rho}} = \frac{\rho^2}{W}$

1 Ohm = $\frac{(6046.5)^2}{1}$ feet

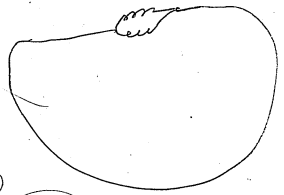
$WR = \rho^2$ $\quad R = \rho$

$\rho W = \rho^3$

173

Table

$N = \frac{\rho^2}{R}$



Portland

Dickenson Sh. Mfg.

Lawson will make a solution a Cu. Sulphate and put Oxide of Cu. into it. You will try it and see how it works. Get Lawson to write what he does and help him.

No. 4 27.054 7
5 20.599 3
No. 8 18.9445 12

Nov. 8 1879 151

~~20.70~~

No. 4	27.047	27.047	0.0
No. 5	19.885	20.582	.697
No. 8	18.250	18.933	.683
No. 10	22.474	22.488	.014

Put in circuit in Solution No. 1 "

100 Ohm Lamps 10 per Horse power

$C^2 R \div 44.3 = 33.00$

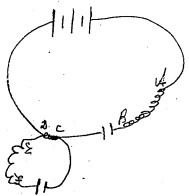
$C^2 = \frac{33}{44.3}$ 1.5185
1.6464
T1.8721

$\sqrt{\ }$ .863 Webers T.9360

Measure the resistance of 1.5 cells by means of the high resistance Galva.

The current may be measured by dividing the E. M. F. on AB by the resistance of AB.

The resistance of the shunt BC will be to the resistance of AB as E. M. F around BC is to the E. M. F around ABC.



178

No. 1 Solution

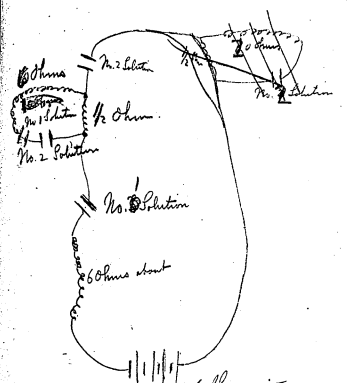
Copper Sulphate C.P

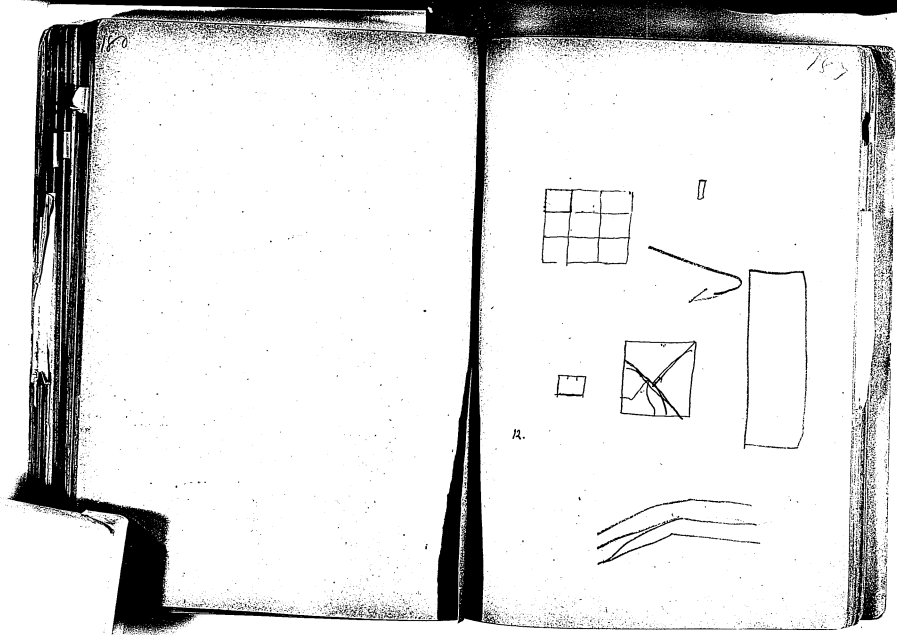
"Just enough ammonia added to neutralize any free acid if any were present" Lawson

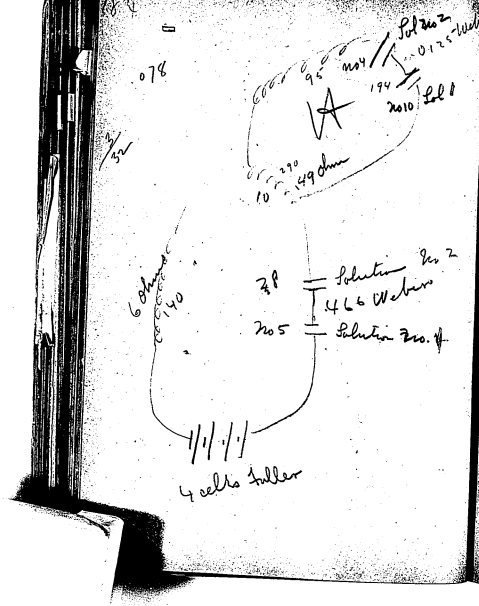
No. 2 Commercial Copper Sulphate

No. 1 worked very well plates in it 3½ hours gained in two cases 7 & 12 mg. and lost in another 5 mg. showing as far as the case was taken no change

179







Current started at 5:05
2 – 45 P.M. (my watch)

Made 4 cells of Daniells 216
50 deflection = 1 Volt

$\frac{140}{50} = \frac{2.8 \text{ Volts}}{6 \text{ Ohm}} = .466$ Webers

Around 6 Ohms

$\frac{60}{140} \times 6 = \frac{30}{70} = \frac{3}{7} = .428$ Ohms

$\frac{119}{50}$ $\frac{119}{140} \times 16 \frac{3}{70}$ $70\overline{)357}$ 5.1 Ohms

305) 300.9 (.983
2745
2560
2440
1000

300 : 148 :: 305 : 49

101.66
.48

300 on 305 .49 Ohm

48 on X shunt

X = .49 Ohm

290 on X shunt

95 on 6 Ohm in

194

289

95 2

.466 Webers

Let x = no divisions / Volt

$$\frac{290\frac{1}{X}}{.49} = .466$$

$$\frac{1}{X} = \frac{.466X \cdot .49}{290}$$

$$X = \frac{290}{.466X \cdot .49}$$

1270

2.4624
10.3316
10.3098
3.1038

Plate

95
1270
6

1.9777
6.8962
9.2218
$\bar{2}$.0957

.0125 Watson Fleming in Branch A p. 184

$\bar{1}$.6684
$\bar{2}$.0957
1.8727

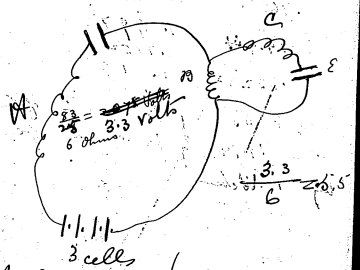
37 times the resistance in Branch that there is in Shunt or it is equivalent to that amount in building back the E.M.F.

Heat 75 minutes

	697 mg	2.8432
Comp	75	8.1249
Comp	.466	10.3316
	19.944	1.2997
		1.7782
	.3324 mg	7.5215

Deposit .332 mg per account of Cu.
" 19.94 mg per minute of Cu.
by I. Weber

Nov. 11, 1879.



A 300
B 48.5

B 311 – 312
B (Copper) 330
C 212
E 97

$\frac{3.6}{6} = .55$ Webers

$\frac{311 \times \frac{1}{x}}{.49} = .345$

$\frac{x}{311} = \frac{.49}{.345}$

$= \frac{311}{.49 \times 345}$

1840

212
1840 X 6

T. 6902
7. 5072
10. 4622
3. 6576

2.4928
10.3098
10.4622
3.2648

2.8263 2.3263
7.5352 6.7352
9.7218 9.2218
8.5833 8.2833

.0192

3458 2.5378 .345 2.5378
30.3 1.8833 .019 8.2833
.9548 2.2543
318.

6 cells
4 cells standard to 108.

A 125

B-C. open 149.5

½ A 3 ohms 300.

B ~~326~~ (C. Ohm) 326

B (C closed) 308.5

C 121.4

214
1208
177.6

2.13304
3.08220
7.29847
0.77182
2.47702

~~125~~
~~500~~ Volts on 6 ohms & ohms

~~4~~ 6 ~~ohms~~ Volts on 6 ohms & ohms

~~1~~ ~~Webers~~ 5/6 Weber

$\frac{308.5}{.49} \times \frac{x}{x} = .521$

$x = \frac{308.5}{.49 \times .521}$

2.48915
10.30758
10.28332
3.08225

1208

521 2.7158
1.47702

176

1.24656

6 cells
4 standard 108
A 90 ~~around~~ 3 ohms

B 335
C 239

~~trag~~

196

1 mg in a minute ten lamps

60 mg per hour ten lamps

600 mg per hour

O.K.

198

Meter box made May 4 1879 tried Nov. 14 1879.

Resistance shunt .14 Ohm

Remainder about .06 Ohm

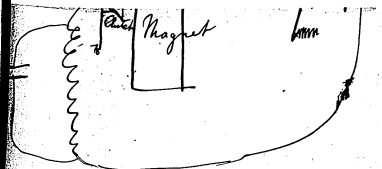
Edison Laboratory Note Book No. 25.

Pages 197 and 198.

Electric Meter.

See Edison Patent:

251,545 (Pat. Dec. 27, 1881.)



1 mg in 2 minutes by Camp

60 mg per hour

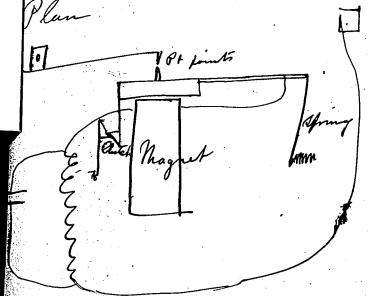
Meter box made May 1879 tried Nov. 14 1879.

Resistance shunt .14 Ohm

Remainder about .06 Ohm

~~Plan~~ Magnet .015 Ohm

Plan



The magnet was strong and broke the current at about ten Webers or less. The jump ~~into~~ arc between the break points kept up for some time after the magnet had clutched

The magnet charged so that the armature was placed nearer the hinge so that the spring would count more and the end would fly more

Meter experiments Nov. 15. 1879

Ten shunt ⅟₁₀ Ohm

Pages 199 to 282. "Electro-deposition Meter Notes."

.03 .05 .10 .15 .20

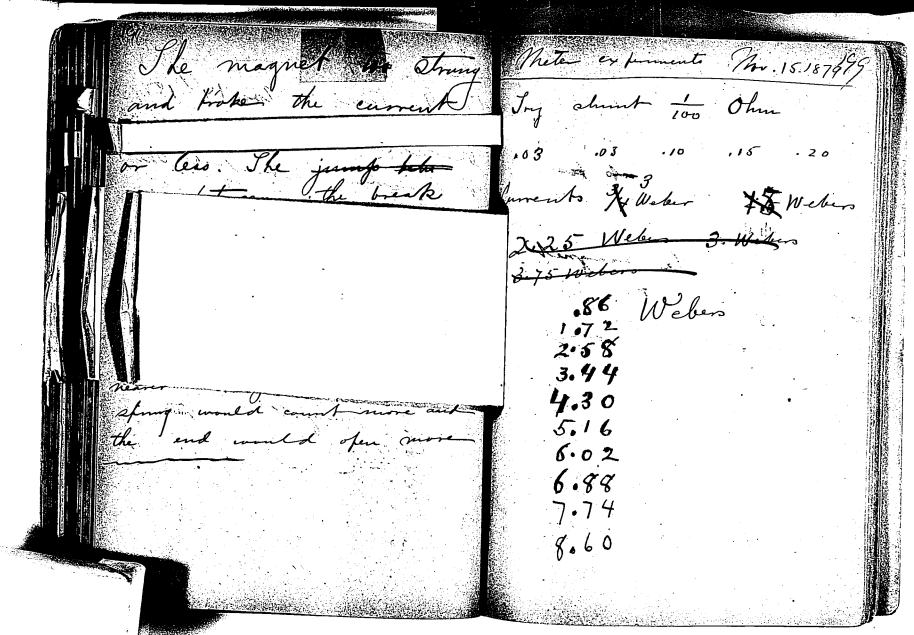
Currents 3 Webers 5 Webers

Edison Laboratory Note Book No. 25.

Pages 199 to 282.

See Edison Patents:
304,082
303,496
281,383
231,345
240,378

5.16
6.02
6.88
7.74
8.60



The magnet was strung and broke the current or vice. The ~~jumps take~~ the break

Never ... spring would count more and the end would open more

Photo experiments Nov. 15. 1879

Troy shunt $\frac{1}{100}$ Ohm

.03 .05 .10 .15 .20

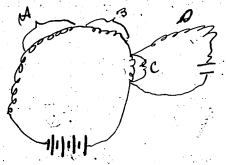
Currents ~~3~~ Webers ~~5~~ Webers

~~2.25 Webers 3. Webers~~

~~2.75 Webers~~

.86 Webers
1.72
2.58
3.44
4.30
5.16
6.02
6.88
7.74
8.60

Shunt $\frac{1}{100}$ Ohm



A = 3.10 ohms

B = .5 Ohm

S = 60 ohms

25)61(2.44

50

110

100

3)2.44

.81

25)65

A = 65

A = 65

$\frac{18\frac{1}{x}}{.01} = 86.$

$18\frac{1}{x} = .86$

$x = \frac{18}{.0086}$

1.2553

3)3.9345

3)1.3208

2090.00

C = 16

D = 9 over 6 Ohms

9/2090 = $\frac{1}{232}$ Value

25)65

2.6 Volts

.86 Webers

A = 105

C = 31

D = 10 over 6 Ohms

2 cells 108

B 56 1/2 A

54/112 (2.08
108
400

2.08 Webers

C 48

D 15

95

95/54 x 2

54/190 (3.7 Webs
162
380
378

.75

123/73 = 1.68

20897
1.8633
.22.66

29

Nov. 17 1879

~~A 178~~

~~A 169~~

C = .05

2 cells 108 D = 50 for 1 Volt

1/2 Ohm

~~39 on A~~

35 on B

5.35
2
1.4 Webers

73/123 (1.68
73
500
438
620

~~C 130~~

D = 73

C = 123

CX 1/D = 1.4

.05

1/D = 1.4 X .05 / C

.070/123.000
1757

73 1.8633
1757 3.2430
5.6293
10.7752
3.8821
.1461
3.3040

1.4 1461

.00695 1.4

202

~~4753~~ ratio

108 Two cells

108 vs A

~~1.04~~ Volts
~~.68~~ Webers
2.16
.72 Webers

108
216

C_0 5 9 1.7709 C_2 = .05 Ohm
A 31 1.4914
2.885
1.94

31 / 59 (1.90
3
280
279
.68
.59
.0590

09 / 5900
843

034 / 590000 / 1760 = X
34
250
238
120
34
160

.72
.05
.0360

59 1.7709
.036 2.5563
3.2146

1600 31 1.4914 .72 1.8573
comp 1600 6.7854 3.4986
Comp 6 9.2218 2.3587
3.4986

.80315 224

108 Two cells C_2 = .05 Ohms

A = 50 / 148
3 / 2.9.6
.987 Webers
44 / 79 (1.79
44
350
2

C = 79 8796
D = 44 6435
.2791 171

.487
.05
.04935

.08
.8

79 1.8976
.0493 2.6928
1600 3.2048
~~1270~~

~~146 : 108 : 59~~ 2.1703
108 : 148 :: 59 1.7709
7.9666
1.9078

800
.68 : .987 : 59 T.7943
1.7709
10.1675
85.5 1.9327

B = 52

2 Wheels

C = 170
D = 104) 170 (1.65
104
684
624
555

C = 41
D = 20

2.05 - Ratio

A = 1131
3) 2.62 Value
.873 Wheels

C = 56
D = 29) 56 (1.85
29
270
252
180

C = .03

Page 210

A = 94
188
6

03) 5600
1866.
6
11196
1.4624
4.0487
3.4137
.873 7.9410
3.4727
.06297

see Book 26
p. 213

C = .03 Ohm

B = 50

2 Webers

C = 120

D = 62) 120 (1.80

62

580

496

840

558

558

4

B = 51

C = .01 Ohm

102

2

204 Webers

C = 49

D = 25) 49 (1.96

25

240

225

C = .01

A = 102

C = 260

A = 105) 260 (2.38

200

400

315

850

10

1500 lamps 1500 hours in a month. 1 Gramme per lamp

150000

3000 ft. lbs
60
180,000
1500
90000000
18
270,000,000

2700,000

300

10 Grammes

Say $\frac{1}{250}$ of the current in the main line flows through the shunt containing the voltameter

10 per H.P

$\frac{X^2}{100}$ 44.3 = 3300

$X^2 = \frac{330000}{44.3}$

5.5185
8.3536
3.8721
1.9360

X = 86.3 Volts

.863 Webers flowing

Page 191

1994 Mg. of Cu. by one Weber in one minute

19.94
60
1196.40 Mg per hour
1.1960 Gr per hour

24 hours a day

30 days a month

120 hours

150 hours

1.19 0.0755
150. 2.1761
2.2516

178 ratio of Shunt

$\frac{1}{178}$ of Current should go through the shunt

1000 #78

150 hour

200 hours

$\frac{1}{178}$ of current should go

180

5

750 feet per month

750 5 cts an hr

25 $7.50 $7.50

30 $7.50 $7.50 $7.50

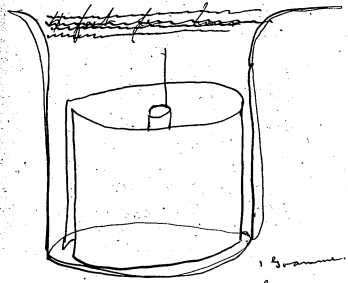
75 feet per month

1 Gramme represent one thousand feet of gas

Supposing that a burner consumes 5 feet per hour

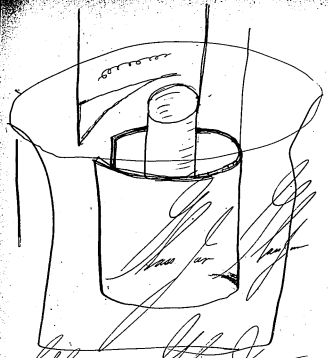
214

200 hours



1 Gramme
1 Gramme
1 Gramme
1 Gramme
1 Gramme
1 Gramme
1 Gramme
1 Gramme
1 Gramme
1 Gramme
1 Gramme
1 Gramme

215



Glass jar
Glass jar
Glass jar
Glass jar with small button
reservoir 2 Ohms
Coiled copper
Glass jar

from Immortal

Francis R. Upton Francis R.
Francis R. Upton Francis R.
Francis R. Upton Francis R. Upton
Francis R. Upton
Francis R. Upton Francis R. Upton
Francis R. Upton Francis R. Upton

Meter Meter Meter

500 ft. per H.P. Turner

500 4 .003 1.3

500. 200 hours

1.19
200
238.00

238 ratio

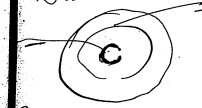
.03 3 6 times

.05 five lamps
.03 ten lamps

.015 twenty lamps

1 Gramme of Cu

Standard cell



Red Red wire +

Green Green wire −

Red wire Green wire

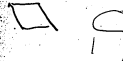
Red wire Green wire

Cell can be made of certain size Must be sealed how Metal cover

Copper does not creep much

Copper does not creep much

Two poles are needed

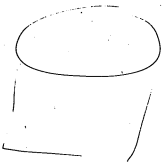


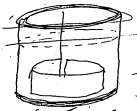
Red and green wires

.03 Ohms for shunt measure wire and wind on magnet

.03 03 safety clutch

03 ?????? ????





Francis R. Upton

Francis R. Upton

Francis R. Upton

Francis R. Upton

Francis R. Upton

Francis R. Upton

Make a jar and resistance
on magnet .03 so that
with .03 in shunt $\frac{1}{238}$ of
the current from two
Lamps will pass through the
meter.

Do makes 4

Better take near 03 and

A coil as warm as to be easy
of adjustment .03 .03 .03 .03 .02 .02 .
.02 .03 .03 .03 03

Every cu. foot of gas
will be measured by a
mg. 1000 mg = 1 g.

Foster sold the same as
light

20 ohm motor
100 ohm lamps

Dec 1st 1879

30 grams pure sulphate copper
100 c.c. distilled water.

Plates = (Dec. 14)

No. 1, 100 c.c. solution tested, 5 m was added 5 c.c. aqua ammonia, then filtered, into bottle, heated gently to drive out air, copper plates in, and sealed.

No. 2. 100 c.c. solution, filtered, poured into bottle, heated to drive out air, copper plates in, and sealed.

No. 3 100 c.c. solution, filtered, poured into bottle, copper plates in, and sealed.

The heat was continued after the plates were placed in the bottles to drive out any air that might be taken in to the solution by adherence to the plates.

Dec 2, 1879

(Dec 1st)

No. 4 Distilled water, Slightly ½ drive out air, stopper placed in and sealed

No. 5 10 grains pure copper sulphate together with 10 grains pure ammonium chloride and 1 grain copper carbonate to 100 c.c. distilled water

No. 6 Same as No. 5 boiling, cooled, heated to drive out air

No. 7, 10 grains copper sulphate and 1 grain copper carbonate in 100 c.c. dist. water

No. 8 Same as No. 7 boiling to drive out air

Dec 3, 1879

No. 4 10 grains sulphate copper in 100 cc. dist. water several times

other placed in bottom
Set this away for one week
then place in strip of polished
copper. The action
set up between the solution
and copper may satisfy
itself on these small pieces,
and then when the strip is
introduced there will be no
further action.

No. 10
10 grains chloride
in 100 c.c. water.

No. 11, Dec. 4, 1874
solution double
sulphate copper and ammonium.

No. 13 Dilute solution impure sulphate
Wallace copper (electrotype)
Weight before put in = 2.522
Taken out Dec. 5, 1874 Weight = 2.517

2582
2575
.007

2.5 22
2.5 17
.005

2.582 ; 2.522 ; .0404 ; X
.007

2582) .017654 (6
15492
2162

.00 6

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No. 14 Dilute solution double sulphate copper and ammonium. Wallace & Tiernan electrolyzed. Weight when first = 2,582+ Dec. 9, 1895 - weight = 2575
Dec. 5, 1895

No. 15 ~~Dec. 5, 1895~~ cupric ~~chloride~~ dull in ~~Ophum~~ ether

~~No. 3 after on the beach~~

No. 2 acted on very slightly

No. 11 acted on very slightly at all

No. 12 very little more than No. 11

No. 11 least

Copper = Sulphate solutions 2 1
for electro-deposition

No. 1 ~~Saturated solution~~ 2 pts Sulphate to 1 water

No. 2 1 pt Sulphate & 2 water

No. 3 1 pt " & 4 "

No 4 1 " " & 8 "

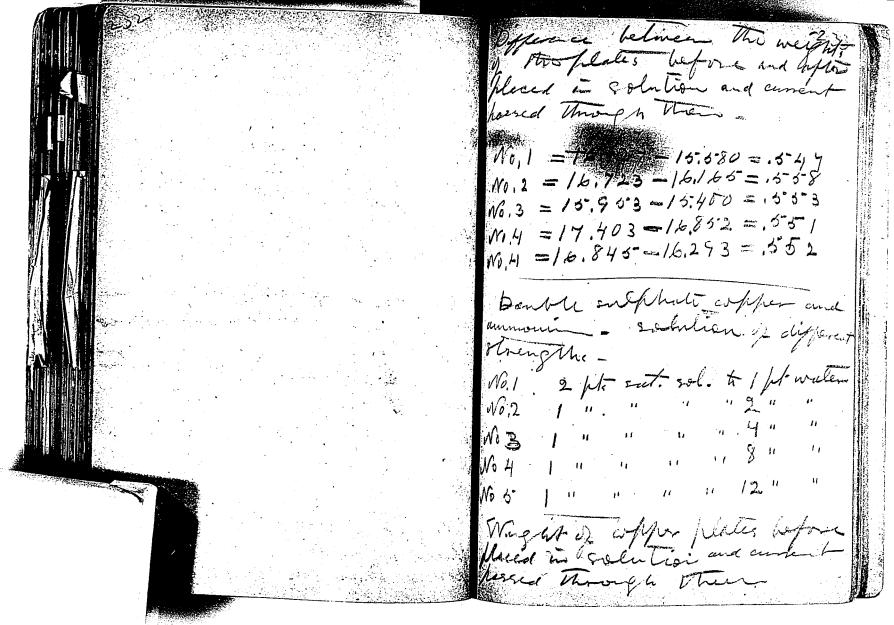
No 5 1 " " & 12 "

Weight of copper plates before
put in solution and carefully
placed through the

No. 1 = 15.5280
No. 2 = 16.1655
No 3 = 15.4005
No 4 = 16.8552
No 5 = 16.293

Weight of copper plates after
placed in solution and carefully
passed through the

No. 1 = 16.1271
No. 2 = 16.723
No. 3 = 15.953
No. 4 = 17.403
No. 5 = 16.845



Difference between the weights of two plates before and after placed in solution and current passed through them.

No. 1 = [redacted] - 15.6580 = .5-4 4
No. 2 = 16.1723 - 16.1665 = .5-5-8
No. 3 = 15.9603 - 15.9500 = .5-5-3
No. 4 = 17.4032 - 16.8512 = .5-5-1
No. 4 = 16.8455 - 16.2923 = .5-5 2

Double sulphate copper and ammonia - solution of different strengths -

No. 1 . 2 pts sat. sol. to 1 pt water
No. 2 1 " . " " " 2 " "
No 3 1 " " " " " 4 " "
No 4 1 " " " " " 8 " "
No 5 1 " " " " " 12 " "

Weight of copper plates before placed in solution and current passed through them

No. 1 = 15.802
No. 2 = 16.442
No. 3 = 15.692
No 4 = 16.588
No 5 = 17.020

Difference between the weight of the plates before and after placed in solution and current passed through them =

No. 1 = 16.807 − 15.802 = 1.005
No 2 = 17.462 − 16.442 = 1.020
No 3 = 16.707 − 15.692 = 1.015

Nos. 4 and 5 N.Ca. the copper deposited on them were spongy and washed off when cold water was applied to them.

Cuprix Chloride gave not satisfactory results

Cuprous Nitrate

No.1, 2 Normal solution to 1/2 normal
No.2, 1 " " to 2 " "
No.3, 1/2 " " to 4 " "
No.4, 1/4 " " to 8 " "
No.5, 1/8 " " to 12 " "

Weight of plates before placed in solutions and solution passed through them.

No.1 = 16.313
No.2 = 16.189
No.3 = 17.353
No.4 = 16.699
No.5 = 17.024

Difference between the weight of plates before and after placed in solutions and solution passed through them.

No.1 = 16.304 − 16.313 = .991
No.2 = 16.185 − 15.189 = 1.995
No.3 = 18.345 − 17.353 = .992
No.4 = 17.685 − 16.699 = .986
No.5 = 18.010 − 17.024 = .986

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Solution 1880

Double sulphate — Copper and Ammonia

No.	Date.	Time.	Weight.	Remarks —
1	Jan. 18	9 PM	28.616	4, 5 and 6 supersaturated solutions —
"	" 20	9 AM	28.633	
"	" 20	12 PM	28.619	
"	" 21	9 AM	28.615	
"	" 21	9 PM	28.610	
"	" 22	9 AM	28.605	
2	" 19	9 PM	29.413	1, 2 and 3 saturated at ordinary temperatures
"	" 20	9 AM	29.400	
"	" 20	12 PM	29.392	
"	" 21	9 AM	29.387	
"	" 21	9 PM	29.383	
"	" 22	9 AM	29.379	
3	" 19	9 PM	28.030	
"	" 20	12 PM	28.009	
"	" 22	9 AM	27.997	
4	" 19	9 PM	28.125	
"	" 20	12 PM	28.096	
"	" 22	9 AM	28.082	
5	" 19	9 PM	29.851	
6	" 19	9 PM	30.000	
1	" 22	9 PM	28.595	
2	" 22	9 PM	29.373	
"	" 23	9 AM	29.368	
1	" 23	9 AM	28.570	
4	" 23	9 AM	28.069	
3	" 23	9 AM	27.985	
2	" 23	9 PM	29.863	
1	" 23	9 PM	28.583	
6	" 23	9 PM	30.026	
5	" 23	9 PM	29.750	
2	" 24	9 AM	29.357	
1	" 24	9 AM	28.577	
3	" 24	9 AM	28.079	
4	" 24	9 AM	28.060	

It is designed to investigate the solutions that in one series of experiments the solutions are at a great strength — At first for a considerable length of time the solution remains in contact with the crystals in this manner is not kept distinct from the solution in the same degree as in the other solutions — The crystals appear as if they had undergone a solution and have the capacity for a slow deposition on the surface, but I have not been able to observe any such action — The solutions are comparatively permanent — 5 and 6 are supersaturated in the other cases [illegible] at the temperature of the room, for each solution [illegible] the same solution —

Solution
Double sulphate copper and ammonia.

No.	Date.	Time.	Weight.	No.	Date.	Time.	Weight.	Remarks
7	Jan 24	8 PM	14.587	1	Jan 26	9 AM	28.552	
8	"	"	7.328	2	"	"	29.340	
9	"	"	3.860	3	"	"	27.962	
10	"	"	10.417	4	"	"	28.037	
11	"	"	5.631	4	"	9 PM	28.546	
12	"	"	3.260	2	"	"	29.335	
13	"	"	7.716	3	"	"	27.957	
14	"	"	4.136	4	"	"	28.022	
15	"	"	2.311	4	"	8	14.558	
1	" 25	12 AM	28.667	5	"	"	7.307	
2	"	"	29.349	6	"	"	3.845	
3	"	"	27.570	9	"	"	10.393	
4	"	"	28.060	10	"	"	5.615	
5	"	"	14.573	11	"	"	3.245	
6	"	"	7.317	12	"	"	7.647	
9	"	"	3.853	13	"	"	4.122	
10	"	"	10.405	14	"	"	2.301	
11	"	"	5.623	15	"	"	14.552	
12	"	"	3.256	7	" 27	9 AM	7.302	
13	"	"	7.706	8	"	"	3.842	
14	"	"	4.128	9	"	"	10.387	
15	"	"	2.306	10	"	"	5.612	
7	" 26	8 AM	14.564	11	"	"	3.244	
8	"	"	7.311	12	"	"	7.692	
9	"	"	3.848	13	"	"	4.118	
10	"	"	10.398	14	"	"	2.295	
11	"	"	5.618	15	"	"	14.538	
12	"	"	3.250	1	"	11 AM	28.538	
13	"	"	7.700	2	"	"	29.328	
14	"	"	4.125	3	"	"	27.949	
15	"	"	2.303	4	"	"	28.022	

Nos 7, 8, 9, 10, 11 and 12 solutions were supersaturated, cooled to 60° F. and to 11 volumes were added one volume of water at the same temperature

Nos 13, 14 and 15 ~~were~~ solutions were saturated at temperature 65° F.

Plates ~~7, 8 and 9 are rectangular~~ ~~3 x 1½ in.~~

" ~~10, 11 and 12 are triangular~~

Plates 7, 8 and 9 are rectangular
$7 = 3 \times 1\frac{1}{2}$ in; $8 = 3 \times \frac{5}{8}$; $9 = 3 \times \frac{3}{8}$ in.

Plates 10, 11 and 12 are triangular
$10 = (4 \times 1\frac{1}{2})\frac{1}{2}$; $11 = \frac{1}{2}(4 \times \frac{5}{8})$ in; $12 = \frac{1}{2}(4 \times \frac{3}{8}$ in)

Plates 13, 14 and 15 are rectangular.
$13 = (1\frac{1}{2}$ in.$)_2$; $14 = 1\frac{1}{2} \times \frac{5}{8}$ in; $15 = 1\frac{1}{2} \times \frac{3}{8}$

The ~~same~~ solution quantity of copper plates, the quantity of copper by which the plates are increased in weight in the solution is a measure of the amount of copper deposited on the plates during the experiment; a correction, also, must be made for the solubility of copper in the solution. The solubility of copper in the solution is a function of the concentration of the solution, the temperature, and the ratio of the surface of the copper plates to the volume of the solution. The ratio of surface to volume should be kept constant in all experiments. The solubility of copper is greater at higher temperatures than at lower. The solubility of copper is also greater in solutions of greater density than in those of less density. Hence

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Book to obtain the constant for ~~copper plate~~ ~~experiments~~ ~~determination of~~ glass plate experiments

Date (Bank, sulphuric office, not exact) (solution saturated at temperature 55°F)

Remarks

No.	Hours	Weight.	Date.	Time
a	00	5.220	9th Jan 24	9.30 PM.
b	00	5.399	" "	" "
c	00	6.140	" "	" "
d	00	18.771	" "	9.30 PM.
e	00	4.795	" "	" "
f	00	5.772	" "	" "
g	00	14.218	" 28	12.0 Noon
h	00	14.462	" "	" "
i	2	14.286	" 29	Temp of solution 3.9°C.
j	"	14.460	" "	3.9°C.
k	"	14.212	" 29	Floats in solution
l	"	14.456	" "	12.30 p.m. Just Touches
m	11	14.207	" "	" "
n	"	14.451	" "	9.40 PM
7		14.531	" "	9.30 PM
8		7.284	" "	" "
9		3.830+	" "	" "
1		28.508	" "	12 Noon
2		28.310	" "	" "
3		27.924	" "	" "
4		27.998	" "	" "
5		28.726	" "	" "
6		26.643	" "	" "
7	11	14.203	" 30	Floats in solution
8	"	14.447	" "	9.00 A.M.
10		10.867	" "	11. AM.
11		5.583	" "	" "
12		3.832	" "	" "
13		7.672	" "	" "
14		4.106	" "	" "
15		2.291	" "	" "

a, b and c - relation between quantity of liquid and loss surface in each = 3 in. = 1 1/2 2

quantities of liquid:

a = 16.1 c.c.
b = 37.0 c.c.
c = 46.0 c.c.

d, e and f - relation between loss and surface -

surface:

d = 12 in. = (4 × 3/2) 2
e = 8 " = (4 × 2/2) 2
f = 3 " = (1 × 3/2) 2

g and h - data for constant loss - surface:

g = 9 in. = (3 × 3/2) 2
h = " " = "

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for instance the vessel A may contain as large a quantity of liquid as the vessel B, but the amount of surface of the liquid surrounding the plate in A is not so great as in B -

In order that a regular action may take place between the surface of the plate and the liquid in contact with it the metal surface must be chemically clean, it is necessary that great precautions be taken to prevent surface oxidation and it is known that such oxidation takes place rapidly under ordinary circumstances, and especial care must be taken that the surface of the plate does not come in contact with anything of an oily nature -

The temperature must also be kept constant as the intensity of the action, as that temperature increases the intensity of the action will probably also increase, as the temperature diminishes the intensity of the action will also decrease -

Lastly ~~Scientific~~ Scientific -

		Weight	Date		
a	#11	14.198	Jan. 30	1.10 PM	* The temperature higher during
b	"	14.449	" "	Same as before	this last 11 hours than in the
a	72	5.208	" "	8.30 PM	two preceding cases. It will
b	"	5.384	" "	" "	be noticed that the loss from
c	"	5.123	" "	" "	a and b is greater for the
a	11	14.1836	" 31	Placed in solution	11 hours than during the
b	"	14.4375	" "	8.30 PM	11 hours preceding the
a	12	14.199	" "	Placed in solution	
b	12	14.433	" "	8.30 PM	
a	43	6.199	Feb 1	8.30 PM	
b	"	6.376	" "	" "	
c	"	6.113	" "	" "	
d	144	18.716	" "	8.30 PM	
e	"	4.774	" "	" "	
f	"	5.749	" "	" "	
d	70	18.407	" "	Placed in solution	* d, e and f were washed
e	"	4.720	" "	12 PM	in nitric acid before being
f	"	5.713	" "	" "	replaced in the solution —
1		28.471	" "	12 PM	
2		29.284	" "	" "	
3		29.901	" "	" "	
4		29.964	" "	" "	
5		29.688	" "	" "	
7		14.488	Feb 2	8.30 PM	
8		7:25 P	" "	" "	
9		3.809	" "	" "	
d	24	18.392	" "	12 PM	
e	"	4.714	" "	" "	
f	"	5.707	" "	" "	

Take a plate of copper and clean it by immersion in nitric acid, washing with water, alcohol, ether, dry it and then plate in the solution of double sulphate and at the expiration of a definite time remove it and clean by washing with water and alcohol, then weigh it; now make it chemically clean in the same manner as at first, weigh again and immerse in the solution as before and at the expiration of the same number of hours as in the first case take it from the solution and wash as in the preceding case and weigh; ascertain the difference between the two weights and compare with the difference between the two weights of the first case — repeat this operation a number of times, making the surface chemically clean, weighing it, placing it in solution, at the expiration of a definite period reweighing it, making a note of the difference between the two weighings, making the surface chemically clean again and

No.	Hours	Weight.	Date.	Remks.
10		10,324	Feb. 2	12 PM
11		5.573	"	" "
12		3.214	"	" "
13		7.648	"	" "
14		4.050	"	" "
15		2.275	"	" "
g	48	14,160	" 3	7.45 PM
h	"	14.407	"	" "
1		25.430	" 5	12 AM
2		25.245	"	" "
3		27.363	"	" "
10		30.310	"	" "
11		5.585	"	" "
12		32.004	"	" "
13		7.631	"	" "
14		4.076	"	" "
15		2.268	"	" "
d	60	18.356	"	12.30 PM
e	"	4.658	"	" "
f	"	5.695	"	" "
a	96	5.178	"	3.30 PM
b	"	5.330	"	" "
c	"	5.056	"	" "
g	24	14,135	"	8 "
h	"	14.372	"	8 "
1		14.450	"	8.30 PM
7		7.236	"	" "
9		3.791	"	" "

so on, after a number of determinations have been made in this way compare the differences between each two weighings, and note the relation between the time and the difference.

The cleaning of the surface chemically clean after each determination is to bring the conditions more nearly equal in each experiment. This taking out, washing and drying of the plate a number of times is to condition it for surface oxidation, and so render the action between the liquid and plate after each determination unequal over the whole surface, but the marking of the surface chemically clean after each determination is to bring the plate into contact with the liquid under conditions more nearly equal in each experiment.

No.	Inner surface	Weight	Date	Time	
1		28.405	Feb 7	1.50 P.M.	
2		29.285	"	" 1.55 "	
3		27.848	"	" 2. "	
10		10.278	"	" 2.05 "	
11		5.540	"	" 2.10 "	
12		3.188	"	" 2.15 "	
13		7.820	"	" 2.20 "	
14		4.067	"	" 2.25 "	
15		2.261	"	" 2.30 "	
d	62.05	15.335	"	" 2.35 "	
e	62.10	4.685	"	" 2.40 "	
f	62.15	5.685	"	" 2.45 "	
a	60.	5.169	"	" 3.30 "	
b	60.05	5.338	"	" 3.35 "	
c	60.10	5.071	"	" 3.40 "	
g	71.30	14.121	"	" 7.45 "	
h	71.35	14.365	"	" 7.50 "	
7	~~71.40~~	14.422	"	" 8.30 "	
8	~~71.55~~	7.217	"	" 8.35 "	
9	60.10	3.768	"	" 8.40 "	
1	125.10	28.370	"	12 7 "	— oxidized slightly at.
2	"	29.185	"	" 7.05 "	— clean
3	"	27.802	"	" 7.10 "	— at.
7	118.40	14.377	"	" 7.15 "	
8	118.55	7.187	"	" 7.25 "	— slightly at.
9	"	3.750	"	" 7.30 "	— clean
10	125.30	10.237	"	" 7.40 "	— "
11	"	5.507	"	" 7.45 "	— "
12	"	3.163	"	" 7.50 "	— "
13	125.40	7.604	"	" 7. "	— at.

We have two plates this weight of 249 each = 10, they are placed in a solution of the double sulphate, one plate is made the positive, the other the negative pole of a battery, a current passes. Transport them, and copper is deposited on one, with an equivalent quantity is with an equivalent quantity is taken from the other, so that one gains the other loses; represent this quantity q 2. Now the solution acts on the copper under precisely acts on the copper under precisely the same circumstances as the current — which, then, and if the current being equal each loses the same weight, call this weight .5 The weight of the plates will now be as follows:

$A = 10 + 2 - .5$

$B = 10 - 2 - .5$

Difference between the two = 4

The current will now be stopped and there is no action opened

No.	Amps.	Volts.	Weight.	Date.	Time.	
15		126.40	2.246	Feb. 12	9.10 A.M.	clean
14		"	4.849	"	9.05 "	"
a		1288	5.145	"	9.15 "	"
b		"	5.309	"	9.20 "	"
c		"	5.042	"	9.25 "	"
d		1288	8.288	"	9.30 "	slightly ot.
e		"	4.658	"	9.35 "	clean
f		"	5.670	"	9.40 "	~~clean~~ ot.
g		122	4.082	"	9.45 "	clean
h		"	4.327	"	9.50 "	"
/		11.35	28.333	"	10.35 A.M.	ot.
2		"	29.144	"	1.40 "	slightly ot.
3		"	27.766	"	10.45 "	clean
7		"	14.361	"	10.50 "	ot.
8		1.85	7.142	"	10.55 "	slightly ot.
9		"	3.724	"	11. "	" "
10		1.35	10.197	"	11.15 "	clean
11		"	5.476	"	11.20 "	slightly ot.
12		"	3.143	"	11.25 "	" "
13		1045	7.590	"	11.45 "	ot.
14		"	4.034	"	11.50 "	slightly ot.
15		"	2.235	"	11.55 "	" "
a		1245	5.128	"	12. M.	" "
b		"	5.288	"	12.05 P.M.	clean
c		"	5.018	"	12.10 "	slightly ot.
d		"	8.270	"	12.15 "	ot.
e		"	4.655	"	12.20 "	clean
f		"	5.655	"	12.25 "	ot.
h		"	4.299	"	12.30 "	partly ot.

on the plates except that of 251 the solution, the surfaces being equal the loss from each will be equal.

In order to determine the weight of copper deposited on A by means of the current it will only be necessary to make the following equation:

a = new weight of A
b = " " " B
q = the original weight of each plate
x = change of copper by current
y = loss " " " action of solution

then;

$$a = q + x - y$$
$$b = q - x - y$$
$$a + b = 2q - 2y$$

Or, as equal surfaces in equal time lose equal weights, the difference between the new weights will be the weight of "exchange" copper.

No.	Inserted yielding	Weight	Date.	Time.	
i	00	2·706	Feb. 18	5.15 P.M.	i, j and k ordinary rolled copper — to see if the action is more rapid than with electrolytic Cu.
j	00	2·513	" "	"	
k	00	1·327	" "	9.15 "	
1	17/155	28,295	" 24	2.30 "	Original
2	"	29.137	" "	2.35 "	
3	"	27.718	" "	2.40 "	slightly enlarged
7	172	14.320	" "	2.50 "	ok.
8	"	7·111	" "	2.55 "	slightly ok.
9	"	3.692	" "	3· "	"
10	17/150	10.137	" "	3.05 "	"
11	"	5.444	" "	3.10 "	"
12	"	3.116	" "	3.15 "	"
13	17/135	7.566	" "	3.20 "	ok.
14	"	4.014	" "	3.25 "	"
15	"	2.118	" "	3.30 "	clean
a	17/145	6.113	" "	3.45 "	ok.
b	"	6.256	" "	3.50 "	clean
c	"	4.987	" "	3.55 "	"
d	"	18.233	" "	4. "	ok.
e	"	4.610	" "	4.05 "	clean
f	"	5.637	" "	4.10 "	ok.
h	"	14.277	" "	4.15 "	ok.
i	187.30	2.6445	" 27	6.45 "	
j	" "	2.4475	" "	" " "	
k	187.	1.264	" "	6.35 "	

In order to carry forward the 253
comparison

Feb. 18, 1888.

A- double sulphate.

Solution containing traces metallic copper = object: to allow the solution to become saturated by acting on the copper; after it has become saturated to be used for further meter experiments - Pg. 270

by the following = (Pgs 254-5)

Plate a, plate in a solution of the double sulphate (newly prepared), and allow the action to go on for some time, then remove, wash and reweigh the plate; now introduce into the same solution a new plate, one which has never been used for experimental purposes, let it remain in this solution as many hours as in the solution was in, then remove, wash and reweigh; repeat this with a fresh plate, and compute the losses

No.	Inches Radius	Weight	Date.	Time.	
1	00	3,314	Mch. 4	1230 P.M.	In these apparatus
2	"	3.012	"	1235 "	ments hard rolled
3	"	3.290	"	1240 "	copper, .005 in. thick
4	"	1.671	"	1. "	was used.
5	"	1.615	"	1.05 "	Three strips of
6	"	1.614	"	1.10 "	plate were used;
7	"	.969	"	1.15 "	large, med. and small
8	"	.9465	"	1.30 "	large = 2 × 2 in. on
9	"	.942	"	1.25 "	one side.
10	"	1.5425	"	1045 "	med. = 2 × 1 in. on
11	"	1.410	"	1050 "	one side,
12	"	1,172	"	1055 "	small = 2 × ½ in. on
13	"	1042	"	11. "	one side.
14	"	.963	"	1105 "	Two kinds of
15	"	1.168	"	1110 "	solutions. ordinary
16	"	3.1575	"	1245 "	copper sulphate
17	"	2.460	"	1250 "	and the double salt
18	"	2.9815	"	1255 "	of copper and
19	"	3.264	"	3. "	ammonia.
20	"	2.984	"	305 "	Sp. gr. of copper
21	"	3.317	"	310 "	sulphate, 1.21 at
22	"	3.109	"	315 "	75° F.
23	"	2.948	"	320 "	Sp. gr. of the double
24	"	3.2653	"	325 "	sulphate, 1.14 at 77° F.
19	12	3.2587	"	3. P.M.	
20	"	2.9787	"	305 "	2, 4, 5, 6, 7, 8, 9 and 19
21	"	3.3107	"	310 "	cut from a different
22	"	3.1035	"	315 "	sheet of copper than
					the others.

Feb. 2, 1880. 2 P.M. Bikromate

Three freshly prepared cells were taken, an entire resistance of 600 Ohms used, and 3 cells, each containing an equal quantity of a solution of the double sulphate copper and ammonia, placed in circuit, each cell contained two copper plates — the surfaces of the plates were all equal — the one as "receiver" the other as "replenisher" in the deposition of copper by the current — Feb. 3, 2. P.M. The plates were removed from the solution, washed and weighed.

The following are the weights before and after the action of the current =

Cell No. 1 $\frac{14.9225}{3.8860}$ " $\begin{cases} 15.2200 \\ 13.5883 \end{cases}$

Before After

Supposing one plate used

	One plate	Two plates
No. 1.	275 Millgr in place	286
No. 2.	280 "	282
No. 3	274	285

add 5 Millgr

	Error
No. 1	280	− 6 Millgr
No. 2	285	1% error + 3
No. 3	279	− 6

Page 258 suppose one plate used

	One plate	Two plates
No. 1,	62 Millgr in place	68.5 Millgr
2,	62 Millgr " "	65.2 Millgr
3,	62 " " "	67.5 Millgr

add 5 Millgr

67	error	− 1.5 Millgr
67		+ 1.8
67		− .5

257

Cell No. 2

15.897	6.167
14.440	14.145
Before	After

Cell No. 3

15.413	15.687
14.458	14.161
Before	After

The amount deposited in each case was worked out by means of the following equations:

$$a = y + x - 7$$
$$b = y - x - 7$$
$$a + b = 2y - 24$$

The following are the amounts deposited in cells 1, 2 and 3 respectively.

No. 1.	.286	per hour .0119
" 2	.2826	.0117
No. 3	.285-5-	.0118
		per minute .000198
		.000195
		.000196

Per Weber estimated
.0196 per minute
19.6 Millgr

No.	hours in solution	Weight	Volt.	Time.	
23	12	2.9425	Mch. 5	3.20 P.M.	1, 2, 3, 16, 17, 18, 19
24	"	3.260	" "	3.25 "	20, 21, 22, 23, 24 - clamps
19	00	3.252	" "	5. "	singes in 200 c.c.
20	"	3.2545	" "	5.05 "	the solutions
21	"	3.4045	" "	5.10 "	1, 2, 3, 19, 20, 21 in
22	"	3.3075	" "	5.15 "	copper sulphate solution
23	"	3.307	" "	5.20 "	16, 17, 18, 22, 23, 24 in
24	"	3.021	" "	5.25 "	double sulphate solution
19	24	3.242½	" 6	5. "	4, 5, 6, 10, 11, 12 used
20	"	3.246	" "	5.05 "	singes as in copper
21	"	3.395	" "	5.10 "	sulphate solutions.
22	"	3.257½	" "	5.15 "	4, 5 and 6 in 200 c.c.
23	"	3.297.5	" "	5.20 "	10, 11 and 12 in 100 c.c.
24	"	3.0115	" "	5.25 "	
19	00	2.933	" "	12. P.M.	7, 8, 9, 13, 14, 15 used
20	"	3.209½	" "	" "	singes in copper
21	"	3.218½	" "	" "	sulphate solution
22	"	3.354½	" "	" "	7, 8 and 9 in 200 c.c.
23	"	3.3543	" "	" "	13, 14, 15 in 50 c.c.
24	"	3.1795	" "	" "	
19	48	2.9165	" 8	" "	
20	"	3.1965	" "	" "	
21	"	3.204	" "	" "	
22	"	3.3353	" "	" "	
23	"	3.161	" "	" "	
24	"	3.0685	" "	" "	
19	00	3.249	" 9	1. A.M.	
20	"	3.095	" "	1.05 "	

See page 293 for the plan being used with Nos.

Feb. 3 - 5. P.M.

The same arrangement used. Cells in place of 600 ohms, 2200 were used as outside resistence. The current was passed through the plates for 21 hours - they were taken out at 2 P.M. Feb. 4.

Weights of the plates before and after current had passed through them.

Cell, 1	15.200	Before	15.262
	13.563		13.488 After
Cell, 2	16.1675	Before	16.099
	14.1455		14.207 After
Cell, 3	15.687	Before	15.749
	15.406		15.333 After

The amounts deposited in cells 1, 2, 3 respectively

.0695 .0652 .0675

per hour .0032 .0031 .0032

per minute .00005 .00005 .00005

No.	Days cultured	Weights	Offspring	Date	Time	
21	10	3·1165		Feb 9	1.10 P.M.	
22	"	3·2559		"	1.15 "	
23	"	3·2749½		"	1.20 "	
24	"	3·4103¼		"	1.25 "	
19	48	3·206	·013	11	1. P.M.	
20	"	3·063	·012	"	1.05 "	19, 20 and 21 signs of oviposition having commenced
21	"	3·1035	·013	"	1.10 "	
22	"	3·2395	·0155	"	1.15 "	
23	"	3·2605	·0183/4	"	1.20 "	
24	"	3·392	·0183/4	"	1.25 "	
19	50	2·999		"	6.30 "	
20	"	3·0535		"	6.35 "	
21	"	3·058		"	6.40 "	
22	"	3·0105		"	6.45 "	
23	"	2·858¼		"	6.50 "	
24	"	3·165		"	6.55 "	
19	60	2·992	·007	13	6.30 P.M.	19, 20 and 21 throwing off ovipositor
20	"	3·045	·008	"	6.35 "	
21	"	3·052	·006	"	6.40 "	
22	"	2·783	·0275	"	6.45 "	
23	"	2·833½	·025	"	6.50 "	
24	"	3·139½	·2263/4	"	6.55 "	
1	252	3·237½	·0953/4	14	12.30 "	they slightly ovipositing
2	"	2·947¾	·0413/4	"	12.35 "	
3	"	3·232 5	·0575	"	12.40 "	
4	"	3·067 5	·060	"	12.45 "	
[illegible]	"	2·878	·032	"	12.50 "	clean
[illegible]	"	2·900	·0315	"	12.55 "	
4	"	1·624¾	·0463/4	"	1· "	

Per Weber

Gn: 0195 per minute =
19.5 Milligs

Feb. 5. 2.30. A.M.

Same arrangement used, in place of 2.200 Ohms, 37800 were used. The current was allowed to pass 19.5 hours. They were taken out 10. Feb. 5.

Weights of ~~the~~ plates before and after current had passed through them:

Cell 1	15.262	15.252
	13.458 Before	13.457 After
Cell 2	16.007	15.996
	14.206 Before	14.201 After
Cell 3	13.749	13.738
	15.338 Before	15.330 After

No.	Number of Coulombs	Weights	Differences	Date	Time	
5	252	15·771	·044	Feb.	1·05 P.M.	clean
6	"	15·5778	·0565	14	1·10 "	
7	"	9·7335	·0335	"	1·15 "	clean
8	"	9·035	·043	"	1·20 "	
9	"	9·005	·0365	"	1·25 "	
10	"	14·205	·022	"	1·245 "	
11	"	13·765	·0335	"	1·250 "	Badly oxidized
12	"	1·1395	·0325	"	1·255 "	
13	"	1·029 5	·0125	"	11. "	
14	"	·954	·004	"	11·05 "	
15	"	15·86	·0055	"	11·10 "	
1	00	15·7485		Feb. 24	4·50 P.M.	Solution of $Cu(NH_4)_2SO_4$
2	"	14·1616		"	4·55 "	
3	"	19·446		"	5· "	
4	"	14·5486		"	5·05 "	Sp. Gr. 1·15–7°
5	"	8·1637		"	5·10 "	Copper, electro
6	"	8·0103		"	5·15 "	by 1– 1/32 Thick
7	"	8·445		"	5·20 "	
8	"	4·2523		"	5·23 "	1, 2, 3 and 4 —
9	"	4·2195		"	5·30 "	2X2 in in
10	"	4·1178		"	5·35 "	250 C.C. solution
11	"	4·0523		"	5·40 "	6 and 7 —
12	"	8·5493		"	5·45 "	2X1 in in 250
13	"	8·5795		"	5·50 "	C.C. solution

The amounts deposited in 24 hrs 1, 2, 3 respectively

.0055 | per hours .00282
.003 | .00154
.006 | .00307

~~Per Weber per hour 11 gram~~
~~110~~

Per Weber per hour 7.87 gram

Feb. 8, 5.50 P.M.

5 voltmeters in set; and still resistance = 12,600 Ohms — in voltameter 1, 2 and 3 the surface of each plate greater than in 4 and 5 —

~~Current commenced work 4 hours~~
~~Feb. 9 — was stopped 8 A.M. Feb.~~
Current commenced & was stopped:
work:
Feb. 9 – 1 A.M. Feb. 9 – 8 A.M.
" " – 6 P.M. " 10–12 P.M.
" 11 – 4 P.M. " 11–10 P.M.

~~46 hours Total work in solution~~
~~Feb.~~

No.	Initials	Weights	Difference	Date	Time	
14	00	9.6977		24	555 P.M.	8, 9, 10 and 11 —
15	"	9.8755		"	6 "	
16	"	4.9765		"	605 "	2 X ½ in. in 25
17	"	4.581		"	610 "	C.C. solution
18	"	4.516		"	615 "	12, 13, 14 and 15
19	"	5.1772		"	620 "	2 X 1 in. in 25
20	"	13.6505		26	6 "	C.C. solution
21	"	13.4125		"	605 "	16, 17, 18 and 19
22	"	17.5605		"	610 "	2 X ½ in. in 63
23	"	17.447		"	615 "	C.C. solution
20	18	13.639	.0115	27	12 "	20, 21, 22 and 23
21	"	13.4025	.018	"	1205 "	2 X 2 in. in 25
22	"	17.549	.0115	"	1210 "	C.C. solution
23	"	17.436	.011	"	1215 "	One side of the
20	00	13.639		"	3 "	plate are rough
21	"	13.4025		"	305 "	the other smooth
22	"	17.549		"	310 "	
23	"	17.436		"	315 "	
20	18	13.6335	.0054	28	930 A.M.	
21	"	13.3972	.0053	"	"	
22	"	17.544	.005	"	"	
23	"	17.430	.006	"	"	
20	00	13.4867		"	4.30 P.M.	
21	"	13.2371		"	435 "	

Number of hours plates were in solution = 72

Number of hours current passed through them = 43

Weights before and after being placed in solution and current passed through them —

Cell 1	15.3335	Before	15.3365	After
	15.7193		15.7147	
Cell 2	15.4662	Before	15.4558	After
	14.8447		14.7999	
" 3	15.2562	Before	15.243	After
	14.9869		14.9255	
" 4	11.4221	Before	11.410	After
	11.3665		11.313	
" 5	11.9669	Before	11.918	After
	11.413		11.408	

No.	Hours Interval	Weights	Differences	Date	Time
22	00	17.4191		Mar 29	440 P.M.
23	"	17.3021		"	445 "
20	18	13.4787	.0078	29	830 A.M.
21	"	13.2309	.0062	"	1035 "
22	"	17.4123	.0068	"	1040 "
23	"	17.2952	.0069	"	1045 "
20	00	13.4787		"	330 P.M.
21	"	13.2309		"	335 "
22	"	17.4123		"	340 "
23	"	17.2952		"	345 "
20	18	13.4733	.0052	30	930 A.M.
21	"	13.2227	.0082	"	935 "
22	"	17.4049	.0074	"	940 "
23	"	17.2879	.0073	"	945 "
20	00	13.2165		31	8 P.M.
21	"	13.3636		"	805 "
22	"	14.2231		"	810 "
23	"	14.0785		"	815 "
20	18	13.2115	.0055	April 1	2 "
21	"	13.3551	.0084	"	205 "
22	"	14.2218	.0092	"	210 "
23	"	14.0705	.0078	"	215 "
20	00	13.2115		"	330 "
21	"	13.3551		"	335 "

The temperature of the room during this test 18 hours was 18°.

New plates

About 1/2 the surface of No 20 seemed greasy. Water would not adhere to it.

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Amount deposited in 1, 2, 3, 4 and 5 respectively:

		per hour
No. 1	.023	.000535
2	.022	.00051
3	.018	.000419
4	.020	.000465
5	.023	.000535

per Weber per hour 1.07 gr.

March 9, 1.30 P.M.

1 freshly prepared bichromate all through 1000 Ohm resistance

4 voltameters each containing 275 c.c. solution ordinary Sulphate copper of Sp. Gr. 1.21 at 75° F.

Size of plates in voltameters 2 x 2 in. hard rolled copper .005 in thick.

Number of hours current passed through voltameters 36 hours.

No.	Hours in solution	Weights	Difference	Order	Time	
22	00	1.42218		Original	3.40 P.M.	
23	"	1.40705		"	3.45 "	
20	18	1.32065	.0005	2	4.30 A.M.	
21	"	1.33464	.0057	"	4.35 "	
22	"	1.4216	.0058	"	4.40 "	
23	"	1.40644	.0061	"	4.45 "	
20	00	1.2797		"	3.30 P.M.	Started this time in No 3
21	"	1.31691		"	3.35 "	
22	"	1.40418		"	3.40 "	
23	"	1.38829		"	3.45 "	
20	18	1.27915	.0035	3	4.30 A.M.	strange Lungs # 62
21	"	1.3169	.0051	"	4.35 "	
22	"	1.40372	.0046	"	4.40 "	
23	"	1.38776	.0053	"	4.45 "	
20	00	1.27915		4	3. P.M.	All slightly thickened over the whole surface
21	"	1.3164		"	3.05 "	
22	"	1.40372		"	3.10 "	
23	"	1.38776		"	3.15 "	
20	18	1.27861	.0054	5	4. A.M.	
21	"	1.31583	.0057	"	4.05 "	
22	"	1.40319	.0053	"	4.10 "	strange lungs 68 #
23	"	1.38718	.0058	"	4.15 "	

Weight of plates before and after placed in solution.

No. 1 3.2527 5 — Before — 3.3201 — After

No. 2 3.0077 — Before — 3.0747 5 — After

No. 3 3.2165 — Before — 3.2847 5 — After

No. 4 2.9505 — Before — 3.0155 — After

Loss from plates same as used in these experiments for 36 hours in 200 c.c. same solution as used in these 4 experiments .0155 gr.

Say there was a loss of 16 Milligrs. from these plates for the 36 hours in solution

Then the amount

No.	Length of solution	Weight	Difference	Date	Time
1a	00	13·877		Aug 5	3· P.M.
2a	"	13·801		"	305 "
3a	"	13·656		"	310 "
1a	18	13·8735	·0035	6	9· AM
2a	"	13·9568	·0042	"	905 "
3a	"	13·6525	·0035	"	910 "
20	00	15·2568		7	3· P.M.
21	"	15·9916		"	305 "
22	"	15·2431		"	310 "
23	"	16·1722		"	315 "
20	18	15·2891	·0077	8	9· AM
21	"	15·9835	·0081	"	905 "
22	"	15·235	·0081	"	910 "
23	"	16·1642	·008	"	915 "
24	00	6·7713		8	430 P.M.
25	"	6·7929		"	435 "
26	"	6·7419		"	440 "
27	"	6·7543		"	445 "
20	"	15·2891		"	330 "
21	"	15·9835		"	335 "
22	"	15·235		"	340 "
23	"	16·1642		"	345 "
20	18	15·282	·0071	9	930 AM
21	"	15·9765	·007	"	935 "

Plates used in formation of 1a, 2a, 3a, 20, 21, 22, 23 were removed in H2O, 3 placed in 2·5·0 c.c. solution of dextrose and after which had been acting on the plates for 3 hours. The plates were then washed in running water for 2 hours. The plates remaining in the solution for 18 hours were found to be acidified.

New plates

Average Temp. 68·5 F.

Hard rolled copper 64 — Plates of this copper — Fresh solution 2·5·0 c.c. C (NH4)2 (SO4)2

Weights of plates will be

No. 1 — 3·3336 − 3·2527 = ·0833

No. 2 — 3·0907 − 2·9907 = ·0834

No. 3 — 3·3007 − 3·2165 = ·0842

No. 4 — 3·0314 − 2·9507 = ·0810

Deposit per hour 2·31 Milligrs.

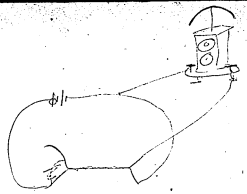
Per Weber per hour 1·15·5 grms.

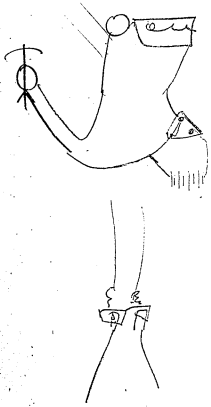
No.	Hours Solution	Weight	Difference	Date	Time	
22	18	15·228	·007	9	9·40 a.m.	
23	"	16·157	·0072	"	9·45 "	
24	"	6·7635	·0078	"	10·30 "	
25	"	6·7852	·0077	"	10·35 "	
26	"	6·734	·0079	"	10·40 "	
27	"	6·7462	·0081	"	10·45 "	
20	00	15·1402		10	4 P.M.	
21	00	15·8572		"	4·05 "	
22	"	15·087		"	4·10 "	
23	"	16·0437		"	4·15 "	
24	"	6·5452		"	4·20 "	
25	"	6·6252		"	4·25 "	
26	"	6·639		"	4·30 "	
27	"	6·608		"	4·35 "	
20	18	15·1342	·006	11	10 a.m.	
21	"	15·8514	·0058	"	10·05 "	
22	"	15·0815	·0055	"	10·10 "	
23	"	16·0372	·0065	"	10·15 "	
24	"	6·5393	·0059	"	10·20 "	
25	"	6·6197	·0053	"	10·25 "	
26	"	6·6335	·0055	"	10·30 "	
27	"	6·6026	·0054	"	10·35 "	
24	00	6·5393		11	4·15 P.M.	
25	"	6·6197		"	4·20 "	

Solution 20–27 Average Temp. 67° F.

Results worked out Average Temp. 5.9° F.

No.	Hours Solution	Weight	Difference	Date	Time	
26	00	6·6235		11	4·25 P.M.	
27	"	6·6026		"	4·30 "	
24	18	6·5323	·007	12	10·15 a.m.	Average Temp. 40° F.
25	"	6·613	·0067	"	10·20 "	
26	"	6·6278	·0057	"	10·25 "	
27	"	6·5969	·0057	"	10·30 "	





$\frac{1}{12} + \frac{1}{24} = \frac{2}{24}\frac{1}{24} = \frac{3}{24}\frac{1}{8}$

$\frac{1}{12}\frac{1}{24}$

$\frac{1}{2}$

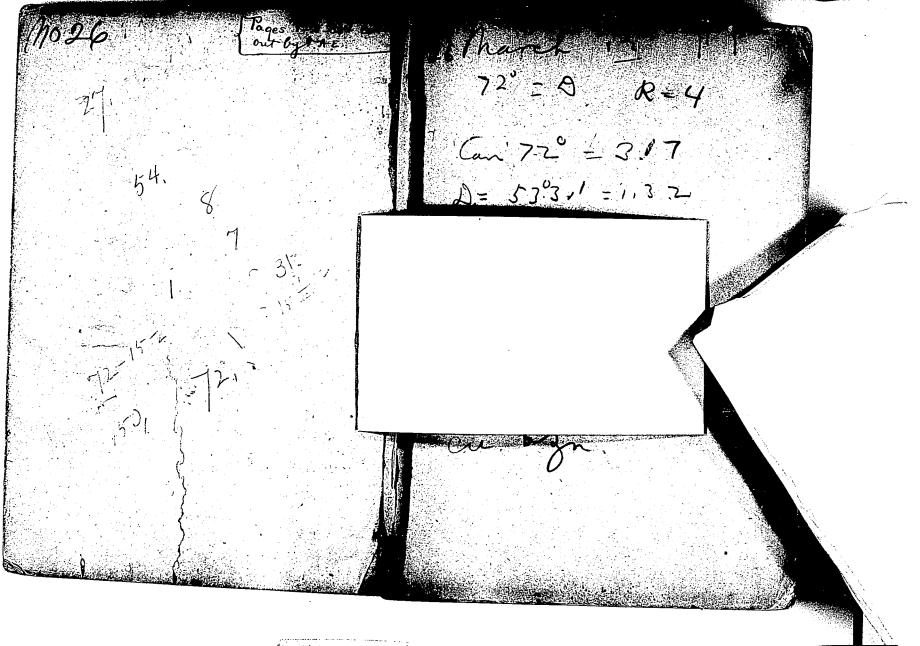
57.45 + 4.75 =
57.45 + 4.75 =
4.25

Menlo Park Notebook #26 [N-79-02-20.1]

This notebook covers the period February-July 1879. Most of the entries are by Francis Upton. There are also entries by Edison, John Ott, and Francis Jehl. Most of the material relates to electric lighting experiments. Included are extensive calculations by Upton about generators and electric power distribution, notes and drawings of lamps and generators, and calculations and drawings of meters. There are also tests of batteries and drawings of telephones. The label on the front cover is marked "Upton" and "Chem. Labor." The book contains 284 numbered pages.

Blank pages not filmed: 54-55, 112-115, 124-129, 136-153, 170-171, 238-245, 250-255, 258-279.

Missing page numbers: 1-4, 281-282.


11026
Pages cut-off
72° = θ R = 4
Can 72° = 3.17
D = 53°3' = 1.32

11026

Pages cut out here

54.

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GENERAL ELECTRIC.

_____, 189

March 1

$72° = \theta$. $R = 4$

$\cos 72° = 3.17$

$D_1 = 53°3' = 1.32$

$1.32 \times 4 = 5.28$

$1.175 \overline{)5.28}\ 3$

525

$3.07 \times 1.32 = 1.175$

3 Ohms Catland

2 cm between the

cu. bgn.

B = $\frac{AB}{A-A_1}$ $R = 4$ Ohms

B = 73°

D = 49° 15'

3.27
1.15
2.12

1.15
4
2.12) 4.60 (2.2 Ohms
4 24
360

2.2 Ohms

Suppose 74°

3.48
1.15
2.33

2.33) 460 (1.9
233
2270
2097
3

mult 76°

401
1.15
2.86

286) 460 (16
286
1740

90° 30'
27°
29°

1 Right

28 30' L

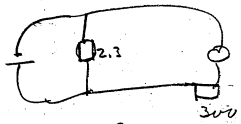
29.30'

29

28.0 R

360

2.3 Ohms
total



9 Ohms

27 Ohms

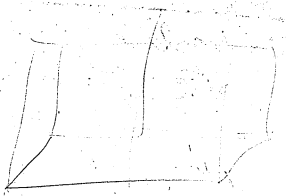
18° 45'

Good cell
.73 Ohms

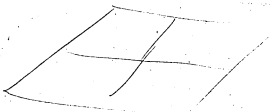
17°
.51 Ohms

73
51
1.24 Ohms

41° 30'



1.7



89 .33

.12	1
.12	2
.11	3
.05	4
.02	5
.02	6
.01	7

14

1 20 ohms 3 speeds Number marked No. 30 or 29
10
10

1 5 ohms 2 mounted speeds No 27 28
2 2 ohm
5 1 1
3 .5
.2
.1
.1
.05
.02
.01
.01

15

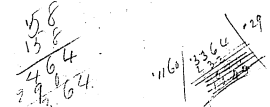
3 1 ohms

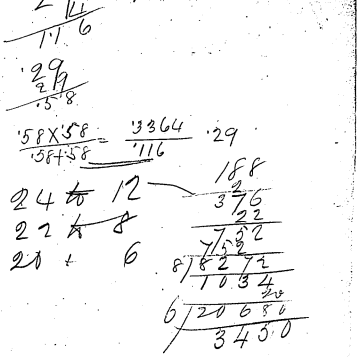
8 1/2

8 1/3

3 1/3 ohms

WL basket
5 lbs. 12 oz





Wt of bucket
5 lbs 4 oz
10° D = 10

2 lbs added
11° = D

4 lbs 3 oz
11° 30' = D

6 lbs 3 oz
D = 12° 30'

8 lbs 3 oz
D = 12° 30'

10 lbs 5 oz
D = 12° 30'

12 lbs 5 oz New Zero
D - 7° New Zero

14 14 4 6 oz
D = 8° 30'

14 5
2 1.5
16 lb 6.5 oz

D = 8° 30'

16 6.5
2 1
18 lb 7.5 oz

D = 8° 30'

18 lb 7.5
2 1
20 lb 14.5 oz

D = 11°

20 lb 3.5 oz
2 3.5
22 lb 12

D = 12°

22 lb 12
2 3.5
24 15.5

D = 14°

24 15.5
2 3.5
27 3

D = 15° 30'

27 3
2
29 3

D = 20°

29 3
2
31 3

D = 22°

31 ohms 30 ohms

2 15

33 45 D = 29

R = 8.5 ohms

33 45

2

35 4.5 D = 29°

R = 4.5 ohms

37 45 D = 29°

37 4.5

2 1

38 5 5 D = 33° 30'

10 inches

2

20

2.0

3.14

12 | 62.80

5.23 ft

5

38.53

5-23

11499

7666

19165

200.4659

200 | 33000

165 minutes

1 HP

102
86
612
816
8772
614040
2632
587

509
60
43540
.0072
81080
18780
326.8840

326

1020.60
138
23 | 1020 (46.3 ft.lbs.
92
100
92
80

44.3 ft. lbs. ~~f~~ given off by one Weber working over 1 Ohm

86	1.9345
.675	1.8293
	1.7638

58 Volts E.M.F.

75.6	1.6785
.760	1.6804
57.	1.7593

86	1.9345
86	1.9345
.675	1.8293
102	2.0086
	5.7069

.82
33 cm
246
246
270 60

509,000

	5.7069
138	2.1392
	3.5670

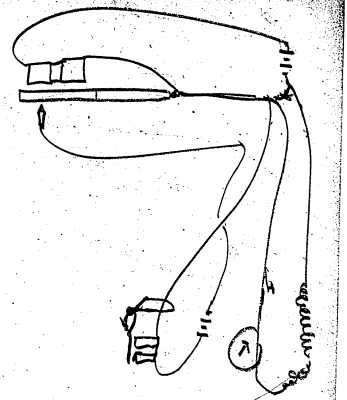
3,690 ft the second

60	1.7782
221.400	
33 cm	5.4815
	.8267

-10

6.7 H.P given off

Rock 8 lbs.



30

Dynamometer

W = 8 lbs No grounding
D = 2° 30
R = 40 + 30 Ohms

W = 8 lbs Grounded
D = 2° 30'
R = 40 + 34 Ohms

W = 10 lbs No grounding
D = 2° 30'
R = 40 + 35 Ohms

R = 40 + 32 Ohms
D = 3 Ground

W = 12 Ngr
D = 3°
R = 40 + 23

p+2 ?

37

W = 14 lbs
D = 3° 30'
R = 40 + 13

New Shunt

W = 10 lbs. D = ?
D = 9° 30'
R = 40 + 32 Ohms

W = 12 lbs. D = ?
D = 11°
R = 40 + 22

W = 14 lbs
D = 13° 30'
R = 12

W = 16 lbs
D = 10.
R = 7 Ohm + 40

W = 18
D = 18° 30'
R = 40

W = 20
D = 20° 15'
R = 36 ohm

W = 22
D = 23°
R = 31 ohm

W = 24 lbs
D = 27°
R =

W = 26
D = 31°

W = 28
D = 37° 30'

W = 30
D =

30

$10 = R$

3.14

3

12 | 31.415

2.618

30

78.540

78.5) 3300.000 (430

3040

2600

2355

245

2/430

215

New Shunt

W = 8 lbs

D = 7°

W = 10 lbs.

D = 8° 45'

W = 12

D = 10° 15'

W = 14

D = 11° 30'

W = 16

D = 12° 45'

W = 18

D = 13° 30'

W = 20 lbs
D = 16° 30'

W = 22 lbs
D = 19° 15'

W = 24 lbs
D = 23° 30'

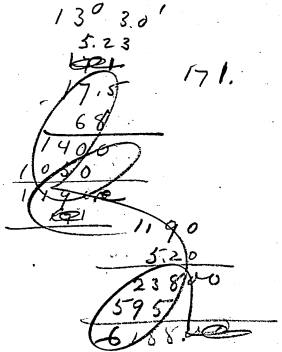
W = 26 lbs
D = 28°

W = 28 lbs
D = 31°

W = 30 lbs
D = 37°

3.14
20
12) 62.80
52.3 ft
13.
1569
523
67.99
68. ft lbs

@ 771
68
1368
1026
17628) 33000 (1/3 H.P.



171 revolutions

17.5

5.23

17.5
171
175
1225
175
3192.5
5.23
6

15-0-0

1

100

11.75	1.0699
192	2.2838
5.23	.7185
	4.0717

11.800

8° 15'

9.5	0.9777
192	2.2838
5.23	.7185
	3.9800

9.550

33000 4.5-18.5

3.9800

.5385

3.4

192 9 1/2

128

1796

1824

7° 30'

8.75 .9420
192 2.2538
5.23 .7185 3.0023
3.9443

8.790 ft lbs

186
590

60

7 .8451
3.0023
3.8474

7.030

30 lbs .4771
180 2.2553
5.23 .7185
4.4509

28000

14° 45'

19 lbs 1.2788
5.23 .7185
180 2.2553
4.2526

18000 ft. lbs.

Gramme 620
commutators with revolutions
3 1/2 Ohms outside

44

19" 45

22.25	1.3472
186	2.2695⁻
5.23	0.7185⁻
	4.3352

21,600 ff lbs

45

34 lbs 1.5315⁻
2.9880
4.5298⁻

33200

10'

11.

Box 8 lbs

4 lbs = W
D = 5° 15'

8 lbs = W
D = 8° 15'

12 lbs = W
D = 11° 30'

14 lbs
D = 12° 45'

16 lbs
D = 14°

18 lbs
D = 16°

20 lbs
D = 17° 45'

22 lbs
D = 20° 15'

24 lbs
D = 26°

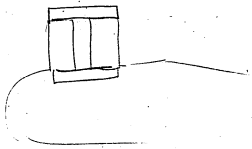
26 lbs
D = 28° 30'

28 lbs
34° 15'

30 lbs.

80) 54.0 (.675
48
60

.67) 4.16



Dynamometer

New magnet and oil cups.

15 cells carbon battery

1 lb constant for deviation Galvanometer using two on shunt 3 inches long. The needle vibrates two wd. Three degrees on either side of the zero as the files ~~and desper~~ cally the shaping machine fashions to be filed.

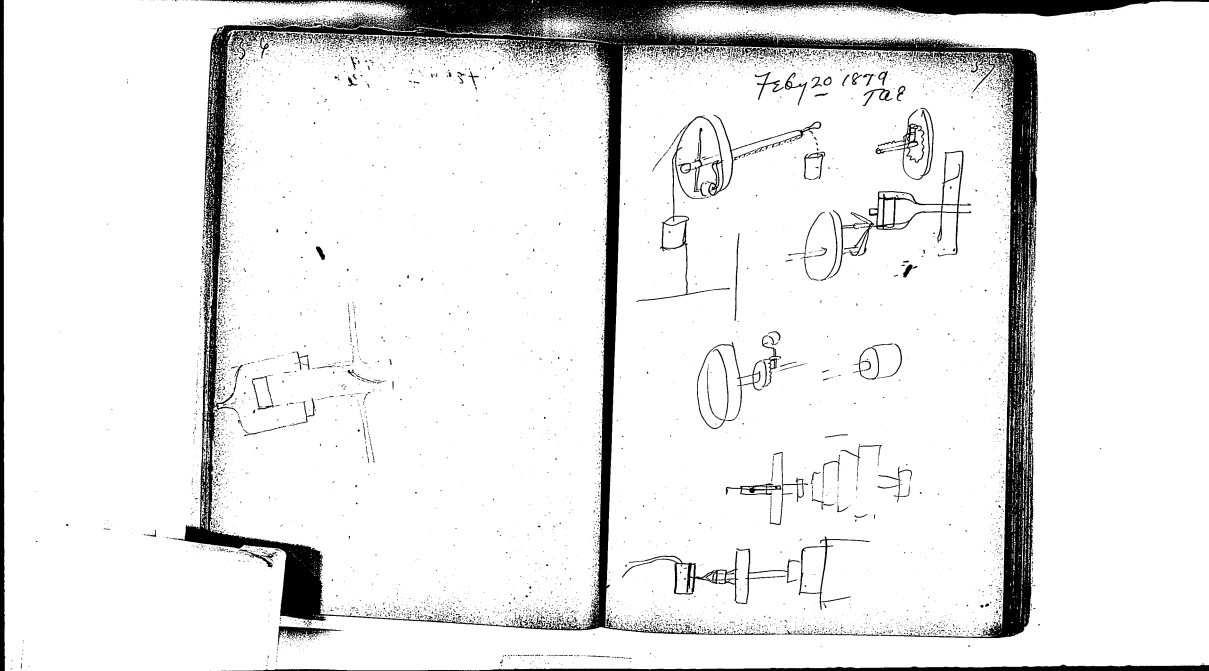
The plate founded on the back

2 lbs	8°
4	11° 30
6	16°
8	19°
10	21° 30' shunt interval
12	25°
14	26°
16	28°
18	30° 30'
20	32°
22	32° 30
24	33° 30'
26	36°
28	37°
30	37°
34	40°
36	43
42	47

35 lbs

2700
35
13500
8100
94500

33000) 94500 (2.8 HP
66
285000
264000
210000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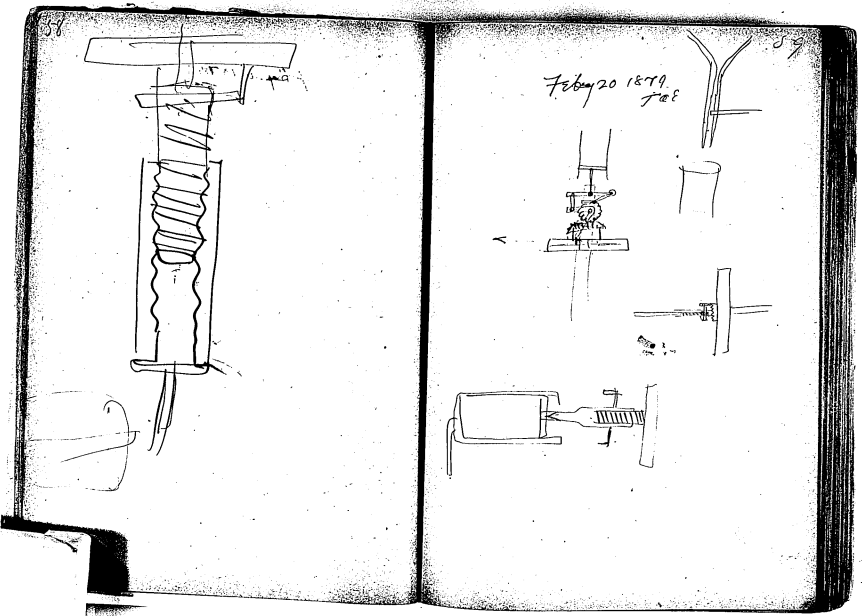
JAB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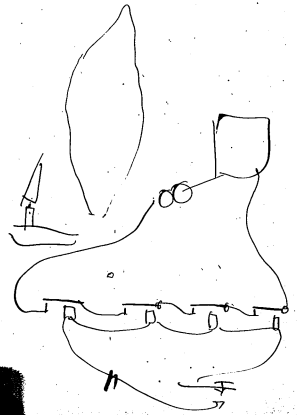

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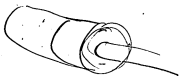

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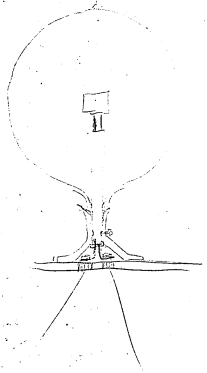
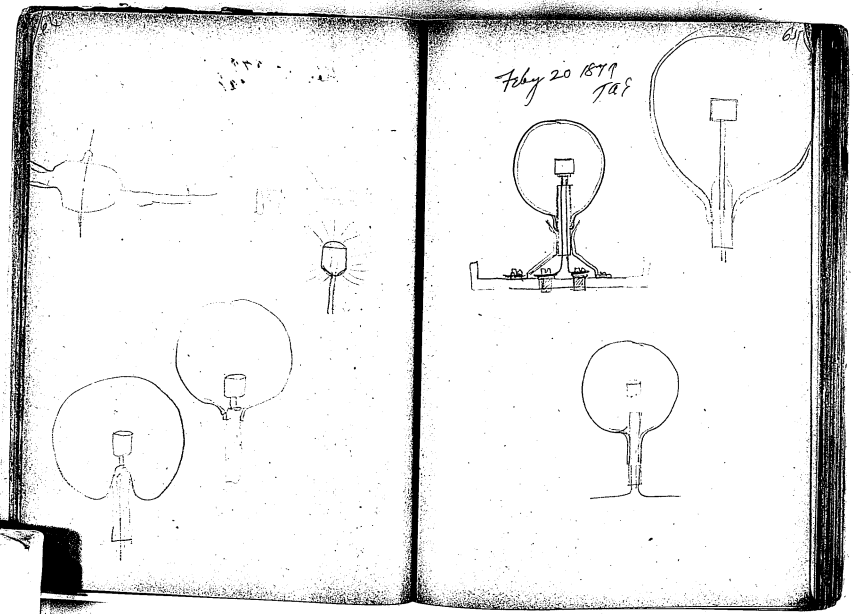
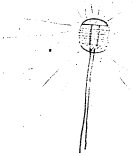



Feby 20 1879
TAE

Feby 20 1879
Jas E



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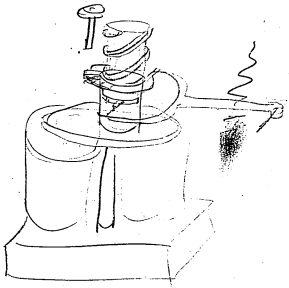

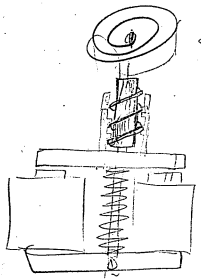

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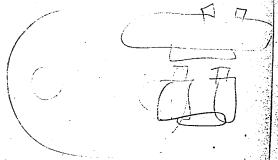

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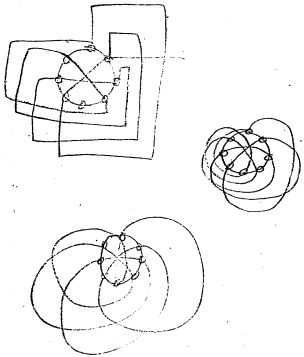

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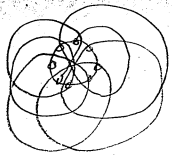

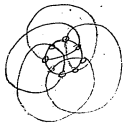

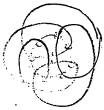

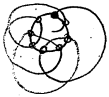

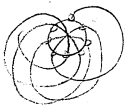

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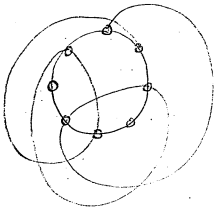
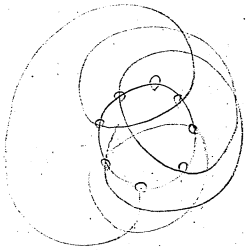
JR.P



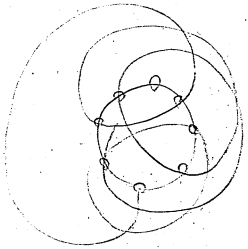


Feb 27 1879 Jas

77

1 3
225 : 77 : 175 : X
175 3
125
175
225
39) 39375

78



Feb 27 1879

17

1 2
22 5 : 7 : 175 : X
3
1 7 5
1 2 5
1 5 7 5
2 2 5
39 375

39

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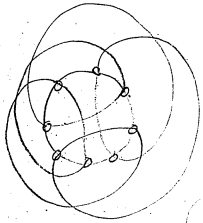

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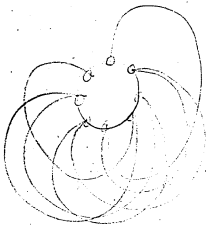

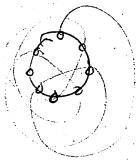

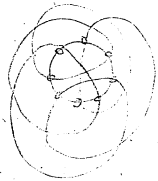

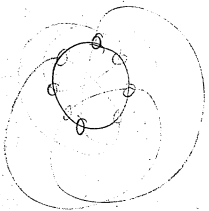

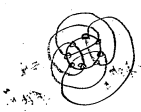

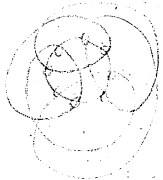

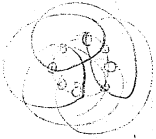

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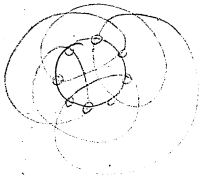

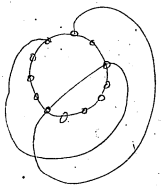

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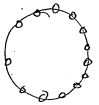
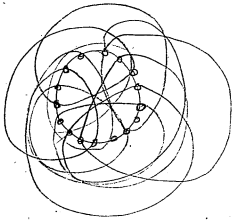
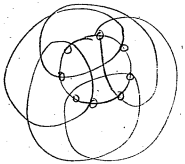




Feby 27 1879
Jas

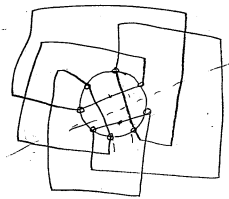


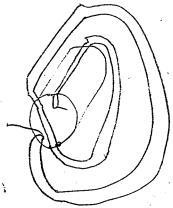
Good
Enough

92

93

Feby 27 1879 Jas





100 cells
~~90 cells~~
10 opposed
~~18~~ 2 Ohms

90 Volts

90
90
~~8100~~
~~1800~~
~~18000~~

8100

100 Volts

---

100 cells
50 opposed

50
50
2500
2
5000

100 cells
10 opposed
1 Ohm total

90 Volts

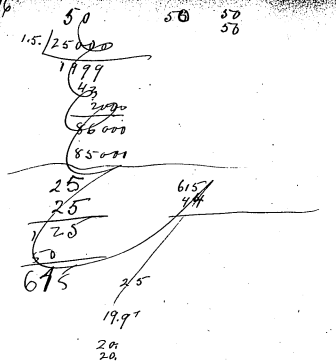
8100 units of E in resistance
90 units in cell

---

100 cells
50 opposed
2500 units of energy in resistance
2500 in work in cell

---

100 cells
60 opposed
1600 units of energy in resistance
2400 units in work in cell



25
25
comp 1.5
44.3

1.3979
1.3979
9.8239
1.6464
4.2661

18,400
3
43.200

50
50
2500

3.3979
9.8239
1.6464
4.8682

73800
2
147,600
73.800
221.400

In the case of two dynamo machines ~~when the~~ one transmitting the other receiving when the electromotive force is in the contrary one is

.25 Ohm 200 ft. resolv receiving to the other hundred 1 Ohm transmitter 100 Volts

25 Volts active

25 1.39794
25 1.39794
comp 1.25 9.90309
44.3 1.64644 1.54945
4.34533

22.100
3
66.300
22.100
88.400

4 | 150
37.5

37.5 1.57404
37.5 1.57404
1.54945
4.69753

49.800
3
149400
49800
199 200

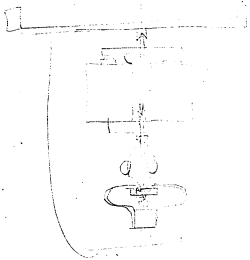
100

37.5 1.5740
37.5 1.5740
Comp .75 1011249
44.3 1.6464
4.9193

83000
3
249000
83000
332000

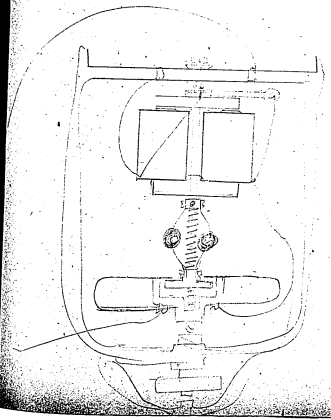
101

March 8 1879
JAE



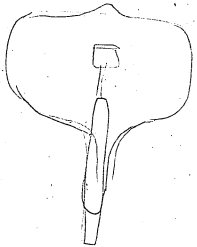
Mch 10 1879

Tai



20. 20 cut 100 000 feet ch

or



1	50 in	50 cut	1	
1	33⅓ in	66⅔ "	2	
1	25 in	75 "	3	
1	20 in	80 "	4	
1	16⅔ in	83⅓	5	
1	14⅓ "	86	6	
1	12 "	88	7	

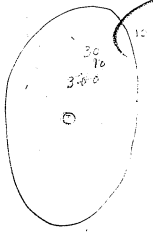
½ 12½ . 37½

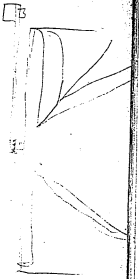
3 . 22

25

March 16 1879

100 TA





20. 1 ch

5 Pighi. 8

5¼

1 ohm 1 ohm

20 Pumps out 20 in 100,000 ffbs

or 5000 ffbs per lamp

~~20 Pumps out 20 in~~

20 Pumps out 6 ½ lamps in 100 000 ffbs

2. 100 000

4 5-8

10. 5 8 25-

15- 5- 50 000

33333 ffbs

15- 33-50

3 150

5 1750

3500

1250

Ap. 1.

25

100,000.

15- 3 ohm lamps 1 ohm machine

Apply 100 = 20 ft lbs

25

or 5000 ffbs per lamp

Can only apply 5000 ffbs

with Standard R. 3350. ft lbs

with 4 lamps R. 2834 "

2834 | 19 2

22 | 2

223 | 7

237 | 6

6 | 2

2850

5

2 | 2 5 0 0

1 | 7 1 0

2850

10 lamp

20 75-

8 75

4

32,300.

35 as against 20

besides having

20

8 : 15 35

32 500

100. 8 75 1. 25

12½ 61 2 5 87 5

7 0 0 0 25

8 5 3/4

47

97 1 48

56

0.047

118 6 00 5 4 5 8

.84 8 8

20 Lamps

March 100 dollars interest 10 year

Cost power 90 per year

$35 per Lamp. 100

Equivalent

4 interest 350, 40

power, 90

only 3.75 per lamp $ 130

$ 5.8 to run 90 64

60 90

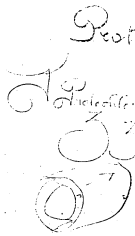
90 : 60 3.07

90 60

63 56

44

Protoclifoxide



Z Zircon

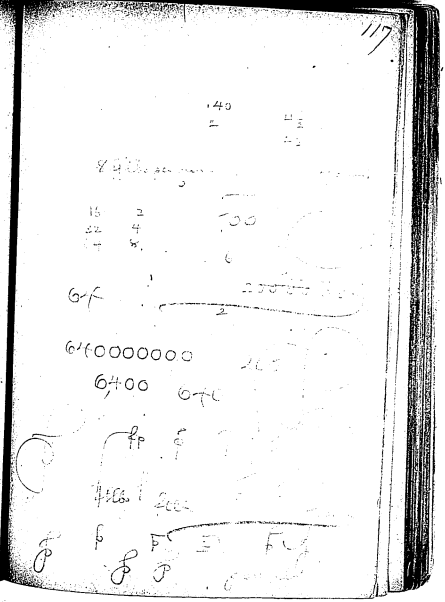
Zirconium

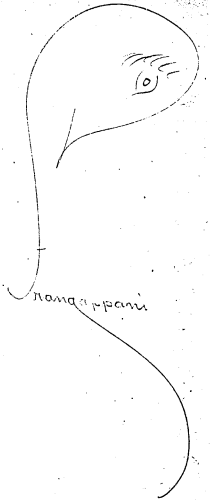
Zirconium

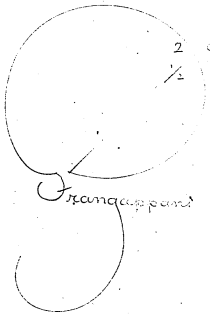
Zirconium

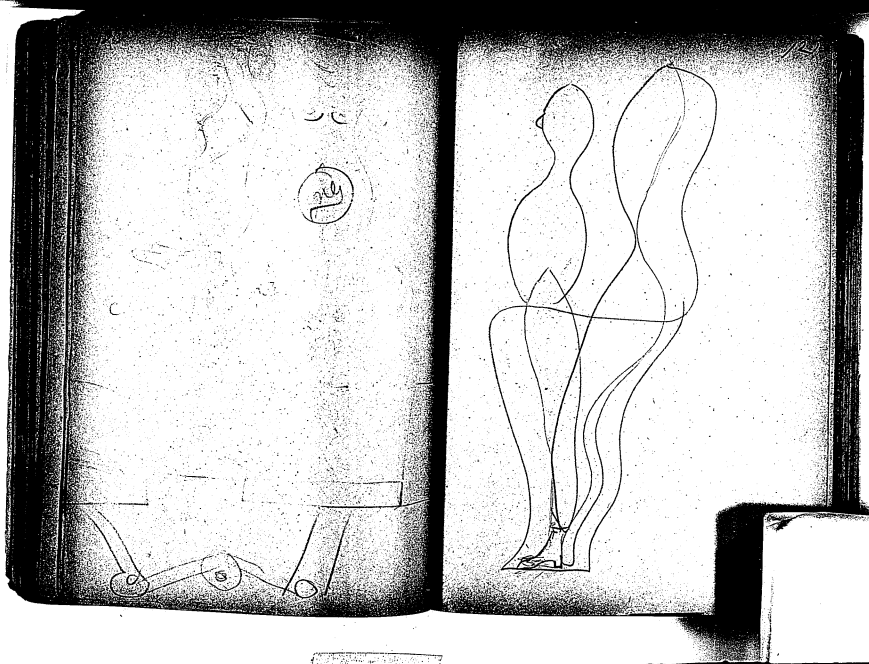
Magnesium

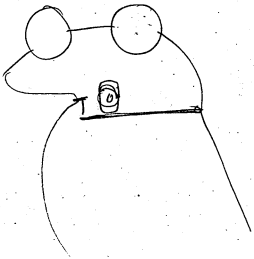
Magnesium



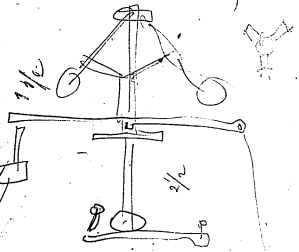

Папаграпи


2 Linien
½
Papagrapti





Mch 20 1879



6

132

66 6666
66
6
3
1½

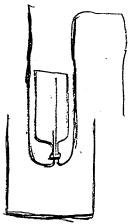
133

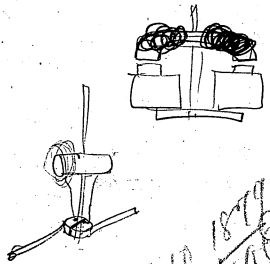
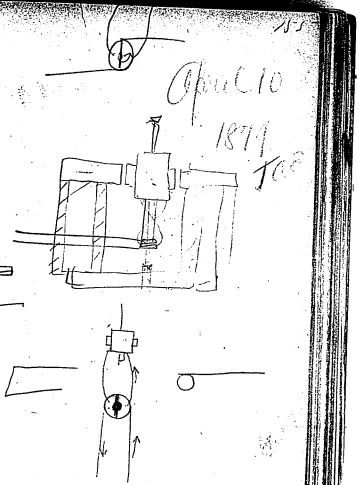
1 in 1 out.

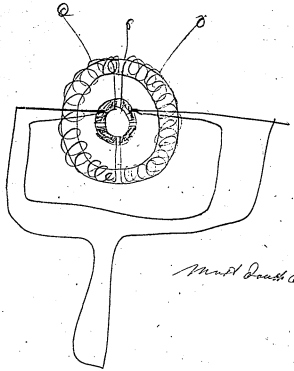
66
4
2/264.
132 Carbon

1326
13 360963
132

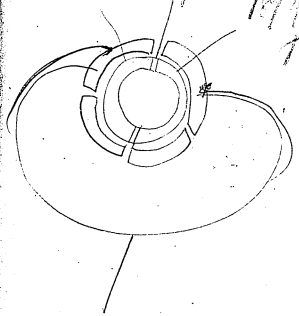
Up 2250

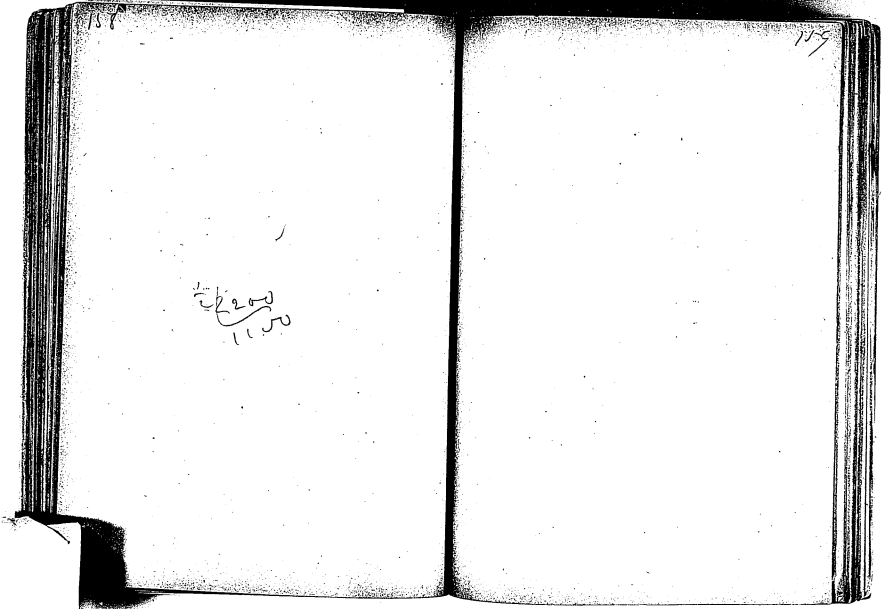


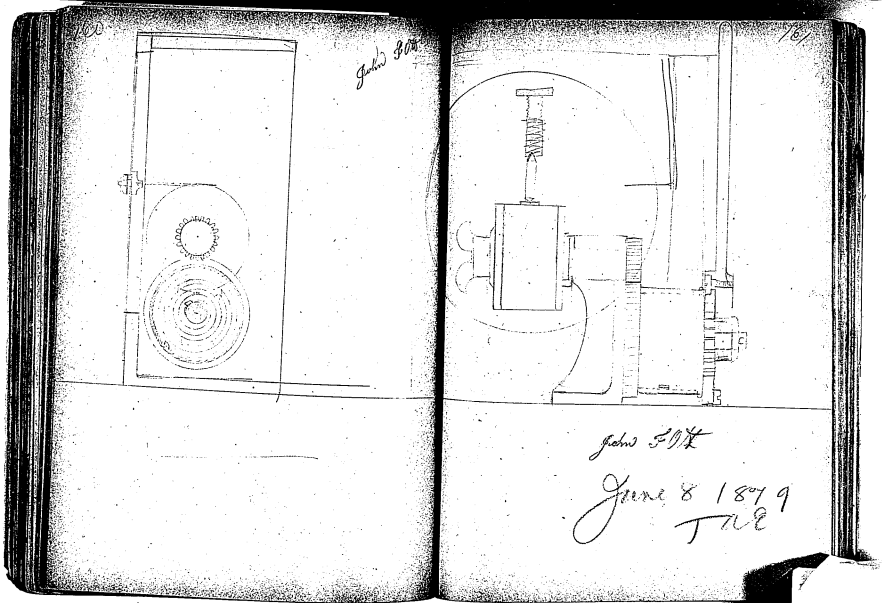

April 10
1879
TAE

April 10
1879
TAE



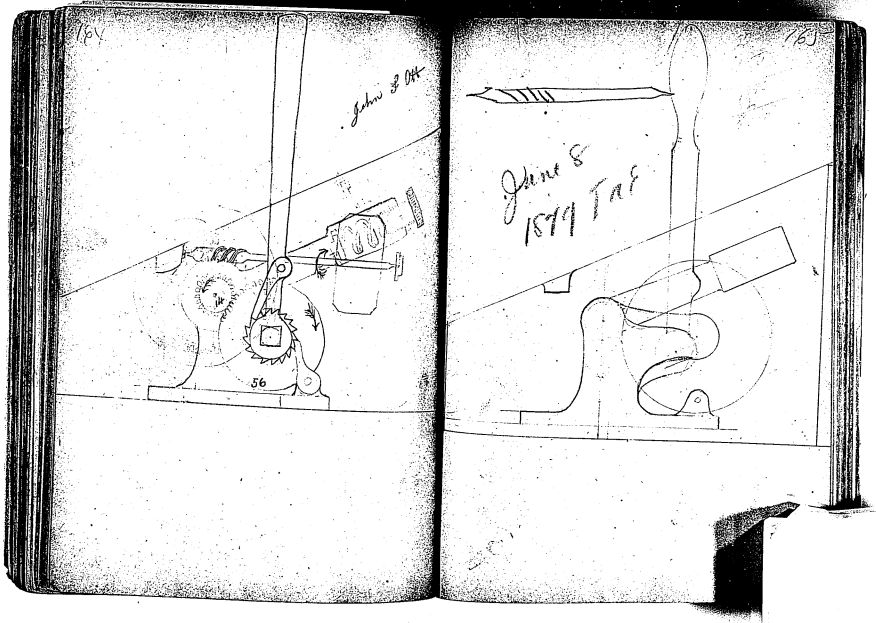
april 10
1971

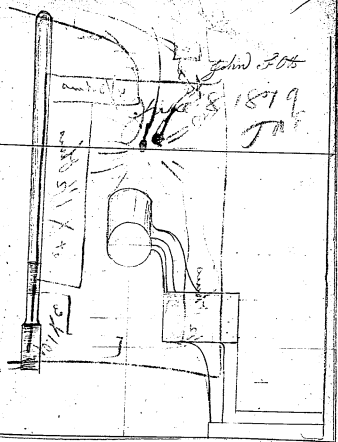


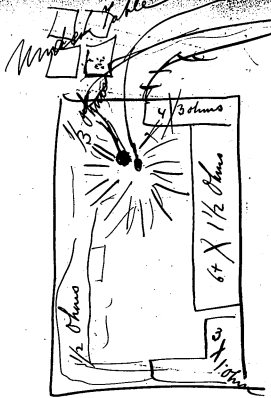


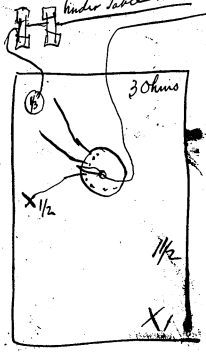

John Fox
John Fox
June 8 1879
TLE

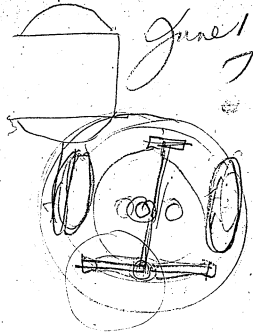
June 8 1879
TMP

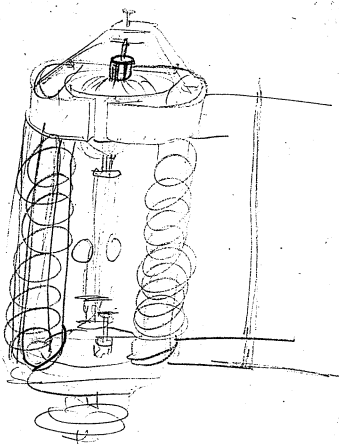

John S Ott
56
June 8
1869 T&F




4 X 3 ohms
6 X 1½ Ohms
3 X
½ Ohms

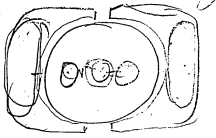

30 Ohms
X ½
1½
X 1



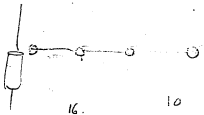


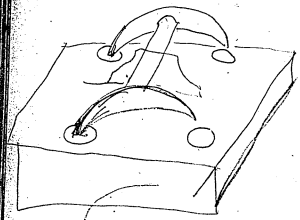
June 1 1879

TAC



16

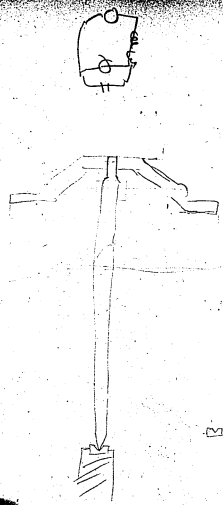




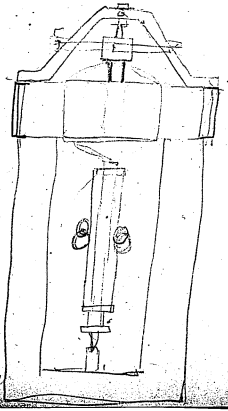
1

June 10 1879
TRT

100, 100,



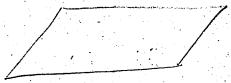
June 10 1879
Jay

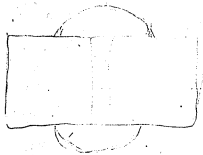


$$\begin{array}{r} 314 \\ 157 \\ \hline 471 \end{array}$$

$$15 \quad \frac{14000}{15}$$

64





P. [illegible]

Resistance of Brandley box
.14 Ohms

Test of Battery 1883

Carbonate of Cu, moistened in porous cup with Cu plate. Outer cell saturated solution Ammonium Chloride Amalgamated Zn.

July
E. M. F. .89 Daniells

Internal resistance 1.4 + .14 = 1.54

Put on short circuit

12-30	M.	32°
1-5	P. M.	25°
1-60	"	21°
3.30	"	21°
4.25	"	19

184

35' Sr. 6 o'clock, after Taking off the currents for a few minutes

27° a.r. from F P. Wm

9.30 a.m. next day 10 degrees being on about ~~it~~ currents are right.

185

35°

186 at 75° F

.35

at 75° F 187

Fuel	Dia.	Rel
50	.040	.35
50	.050	.22
50	.080	.09

188 Large size .127 3/4

12 inches = resistance bridge
12 in of it to make .03 ohms
2 feet to be deducted

47-2 = 45 feet = .03 ohms

.126
.127

9.83 wire from Cu
.1 foot [illegible]

9.82
Comp x128.
x128.
45
1.00382
24.
1091

0.9926
9.8928 = 10
7.8928 = 10
1.6532
.4309
.0374
2.4683

27
2.94 ohms

.00382
24
1528
764
.09168

Temp. 75°7
32
43
5
9 | 215
24.

98%

Another wire .10025

.07 Ohms 71.0692

65 ft 10½ inches

9.82 .9921
100.25 7.9990
7.9990
65 1.8129 94%
2.8030
.0635 .0374
2.8035
.0692 Ohms

9.718 .9872
7.9990
7.9990
1.8129
.0374
2.8355

1692
.99%

9.94 .9974
3.8483
1.8457

7.01 Ohms if compounded

to diameters wires as given by Jenkin.

Take half the log of the wires and subtract 3.4109 from this which gives the log of the Webers

.080

.12 Ohm

70 feet

9.82	0.9921
80	8.0969 - 10
80	8.0969 - 10
70	1.8451
1.09	.0374
	7.0684
.117 .12	7.0792
	.9892

97.6 %

192

.050

.26 Ohm

58 feet 3/4

58.75 feet

	.9921
50	8.3010
.50	8.3010
58.75	1.7691
1.75	0.0374
	1.4006
	1.4150
	.9856

25.1

= 5.1

96.7%.

193

.040 m = D

.41 Ohm

59 feet

	.9921
.09	.0374
40	8.3979
	8.3979
59	1.7709
	1.5962
	7.6128
	.9834

39.4

96.3%

R	7t	Di
.07	66	.1005

.1005 = Diameter

log	9.83	0.9926
comp	100.5	7.9979 - 10
comp	100.5	7.9979 - 10
log	65	1.8129
log	1.09	.0374
		2.8387
	.07	2.8451
		.9936

98.5 %

R				
.07	210	.101 ✓		
		.1005 ✓		
		.101 ✓		
		.1005 ✓		
		.100 ✓		
		.101 ✓		
		.100 ✓		
		.101 ✓		
		.101 ✓		
		.101 ✓	10	110
		.101 ✓	9	100
		.1005 ✓		
		.100 ✓		
		.100 ✓		
		.100 ✓		
		.1005 ✓		
		.100 ✓		
		.1005 ✓		
		.999 ✓		
		.100 ✓		
		.1005 ✓		
		.100 ✓		

July 29 1879

Testing samples of copper wire received from the Anaconda Brass and Copper Works; and comparing it with pure copper ~~at~~ one foot long and $\frac{1}{1000}$ th of an inch in diameter at 0° C.

Large size. ~~1235~~

Diameter. 12 7/4

with the above wire it required above 12 inch of the wire to balance the bridge, and about 12 inch had to be taken, in order to make the rest contain a resistance exactly of .09 of an ohm. Two feet had therefor be deducted which leaves 45 feet.

12 in. R. Bridge + 12 in taken = 24 in

2 ft − 47 = 45 ft = .09 ohms at 75° F.

How do you do

How d

Increase of the resistance of the lamp

25 gram Antaste

Electrotype

Sewing Machine

Conductors

1 Ohm

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

New Machine

Armature Wire .071 1/2 in. in diameter average c/o measurement

Resistance .60 Ohms

The wire all wound

4 5/16 surface 3/16

1/16 1/8 1/16 1/16 1/16

1/16 1/16 1/16 1/8 1/16 1/16

1/16 1/16 1/16 1/16 1/8 1/16 1/16

1/16 1/16 1/16 1/16 1/16 1/16

1/2 the surface ~~1/2~~ the energy on the same surface 2/1

Double the energy quadruples the light. ~~Ex~~ That is on the two halfs of the surface each with the same energy gives off twice the light. Therefore Edison's law halfs the surface and double the light with the same energy

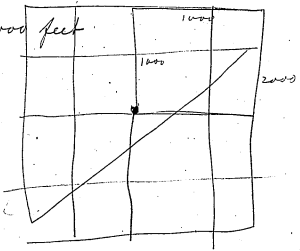
1 1/16 3/16 3/16 5/16 3/16

9 9 9 9 9

202

10 lamps 1/2

2000 feet



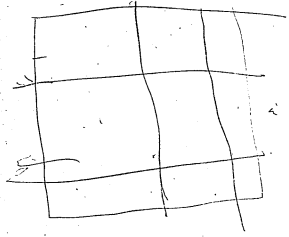
#10 #10

203

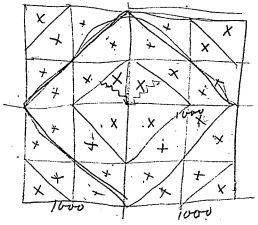
2 wire

5 2 5 2

200/528 2/5 mile



Conductor



$31.25 cost for 1 hour
at distance of 1000 feet or
2000 feet of wire

.79

79 WAB

WAB48

Fall county

Question: How many hours

Say three hours

$30

$10 $20 $30 $30

$20 $20 $20 $30 $30 $30

$20 $20 $20 $30 $30 $30

$30 $30 $30 $30

$30 $30 $30

$30

$30

206

If $30. were invested for each lamp at the hours used at the hour when the most current is required taking three hours as the average use of the full capacity.

207

2 cts an hour

1/2 ct for H.P.
6 hrs H.P.

20 lamps per machine

$5 for machine

$15 for conductor

100 cells
50 cells
1 Ohm
1 Ohm

50

150 cells active

100 cells active
50 ... ...

100 Ohms ÷ 75

25 Volts
1.25 Ohm

20 | 33
1650

11000 | 33.000
3.3

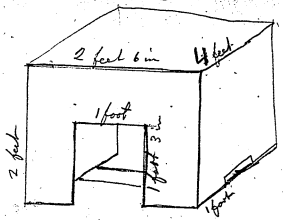
50 50 50 50 50
50 50 50 50 50 50
50 50 50 50 50 50 50

I think the current from a dynamo machine driven by another machine doing work is comparable to that from a battery in which the work is absorbed by another battery

25
6.25
3
1875
44

3.2729
1640
4.9193

83000



larger 26.838

smaller 16.261
16.867
.506

Ten Volts = 100

over 3.56 Ohms 39

39.5

The deflection 70 on .05 Ohms

The deflection 19.5 around 3 Ohms

52. around cell

3.56 | 3.90 (1.09 Webers

3 56

34 00

32 04

1960

1.09 Webers give

70 on .05 Ohm

70 X 20

1.09 | 1400 (1280.

109

310

218

920

1280

3

3840 | 19.500 (.005

19200

300

$\frac{1}{200}$ Of Webers

1 Ohm

30 | 16.6 mg

1.09 | 20.2. | 18.5.

1.09

930

872

580

545

35

18.5

60 | 18.5.

30.83

18.5

60

3 | 1110.0 per hour

277.5

3

5 | 8325

1665

1 Weber deposits 18.5 mg per minute of Cu

.00297

That a current of 3/4 of a Weber shall deposit 5 mg per hour ~~in~~ the deposition cell must be on a shunt so that 1/166.5 of current shall flow through it

In case page 207 Book No 25

.873 Webers | 7.9410

.00297 | 3.4727

2.4683

1/294 of current flowed through the shunt with six Ohms in the line ~~resistance~~ with the cell shunted by .03 Ohm

3-05 P.M

38.5
around 3.56 Chin

215

80 around .05

39 around three others in chunk
58
73

100
1600
160 pesos

The current from four cells of carbon battery allowed to run through a circuit containing a deposition cell and 16.417 grammes were deposited.

A plate was put in the ~~the~~ a shunt and .080 ~~for~~ deposited or $\frac{1}{205}$ of that in the main line.

Measurements with the galva. showed that $\frac{1}{160}$ of the current flowed through the element when the current was strong. This is a good showing for the meter.

20 | 172
8.6
10
18.6
3.27
744
372
558
60.264

3
105
3
324

81 Volts

53 : 245 : 121

53) 245 (4.58
212
310
265
450

81
81
81
648
1561
443
25683
44

4.58
21
458
1
26.78

19.4

19.4	1.2878
4.53	.6561
	1.9439

89 Ohms

81	1.9085
81	1.9085
44.3	1.6464
	8.0581
	3.5215

3320

Test of .042 wire

.047 31.5 feet old
.047 3
.047 94.5 .56 Ohm
.048
.047

.042 new

.80

.041 5
.040 5
.042
.040 5
.041
.040 5

Plan to pursue

Proof that lamps or heaters consume the current in multiple arc or

Those Measured by current

Rey curtain rise in S. in F.
Tests

Berg solution attacked plates
impure plates

Different solution, test
Corrosion loss established

Durable plates

1 lamp $C = \frac{\mathcal{E}}{R}$

n Lamps

$$C = \frac{\mathcal{E}}{\frac{R}{n}} = n\frac{\mathcal{E}}{R}$$

$$C = n\left(\frac{\mathcal{E}}{R}\right)$$

Work in lamps

$$W = C^2 R = \frac{\mathcal{E}^2}{R} \quad W = \frac{\mathcal{E}^2}{\frac{R}{n}} = n\frac{\mathcal{E}^2}{R}$$

$$W = n\frac{\mathcal{E}^2}{R} = n\mathcal{E}\frac{\mathcal{E}}{R} = n\mathcal{E}C$$

proportional to n

Meter deport proportional to n

Meter proportional to Work

Work on lamp $= \mathcal{E}C$

Motor $\frac{(\mathcal{E}-\mathcal{E}_m)^2}{R}$

$$\frac{\mathcal{E}-\mathcal{E}_m}{R} = C$$

$\mathcal{E}-\mathcal{E}_m : \mathcal{E}$ :: Work on resistance : Total Work on Motor

$\mathcal{E}-\mathcal{E}_m : \mathcal{E}$ :: $\frac{(\mathcal{E}-\mathcal{E}_m)^2}{R}$: Total Work on Motor

Total work on Motor $= \frac{\mathcal{E}(\mathcal{E}-\mathcal{E}_m)}{R}$

$$= \mathcal{E}C$$

Work on Motor $= \mathcal{E}C$

The E. M. F. remaining constant the current [illegible] passes through a motor is proportional to the work done whether the work be in the form of heat or motion.

1 Weber of current deposits
19.6 Milligr. in a minute
of Cu.

19.6
60
1176.0 Milligr

1.176 Gr an hour

A 100 Ohm lamps
giving at the rate of
19 lamps for a horse
power in the current
require .864 Webers of
current

1.176
.864
4704
7056
9408
1.016064 Grammes an
hour will be deposited

by the current which
is required to run one
lamps if the voltameter
is placed in the main
circuit

If a lamp consumes 5 feet
an hour and it is wished
to make the meter indi-
cate 5 Milligr the
shunt ratio must be
1.203

5/1.016
.203

If the meter be shunted around .05 ohm there will be an E.M.F of $\frac{.1864 \times .05}{.05} = .0432$ Volts

.043200

The contrary E.M.F of Cu solution is .05 so that it was thought impossible to indicate the first lamp.

Experiments were made that showed that the contrary E.M.F was not a constant but rose with the exciting current being for very weak currents extremely weak

Book 25 page 203

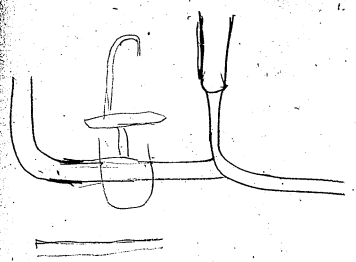
Solutions attached plates

Book 25

Double plates

Book 25 p 255

Tests



165 on Camp

225

73.5

165 : 225 :: 73.5 : x

225
3675
1470
1470

.165) 165 3 7.5 (100.2
165
375
330

19
81

84
84

2796 | 33000 (12
2796
5040
2796
22440

44.3
345392
3453

33000 =
X

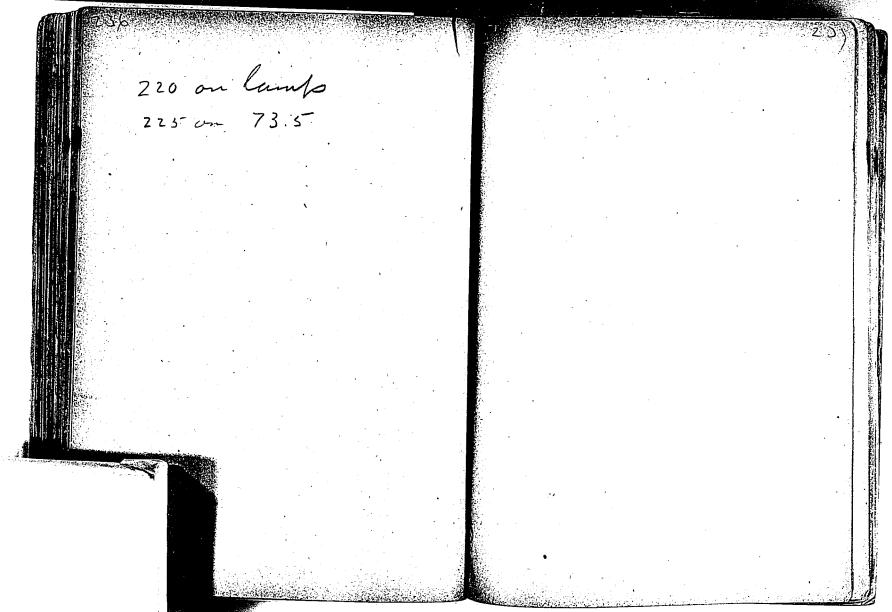
100 ; 81 :: 345.3 : X
81
345.3
27624
27.9.6.9.3

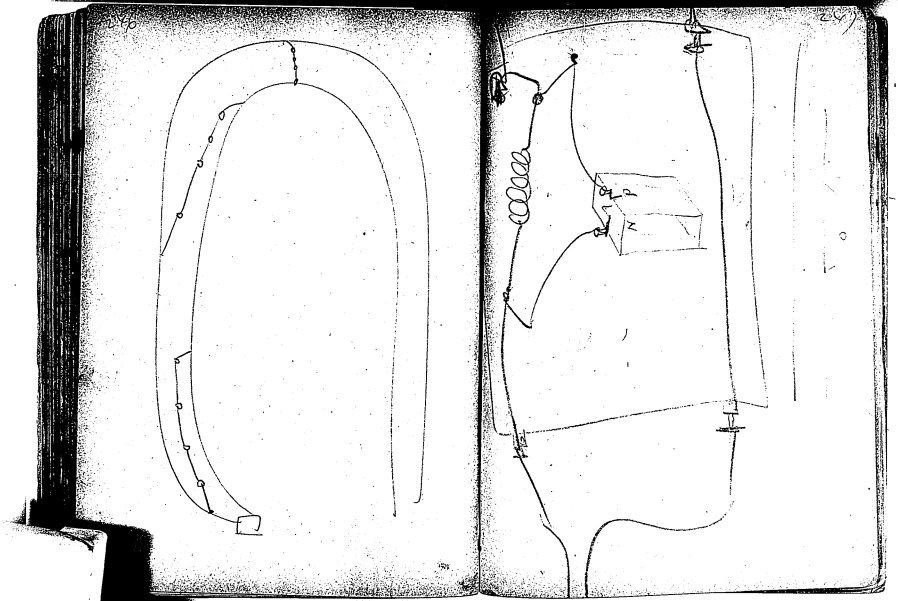
106.6 | 345392 (3240
3198
2559
2132
4272
4264

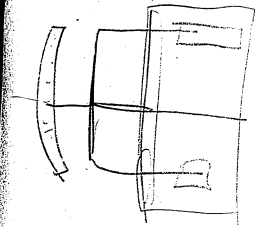
155 : 225 :: 73.5
225
3675
1470
1470
155 | 165375 (106.6
155
1037
930
1075
22
846

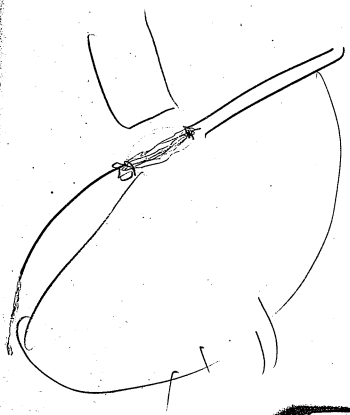
106.6 : 84.6 :: 3240 : 846
20718
13812
26424
106.6 | 2801238 (2
3240
84.6
19440
1296
25920
106 | 274100.0 (2586
212
621
530
910.4
848
620

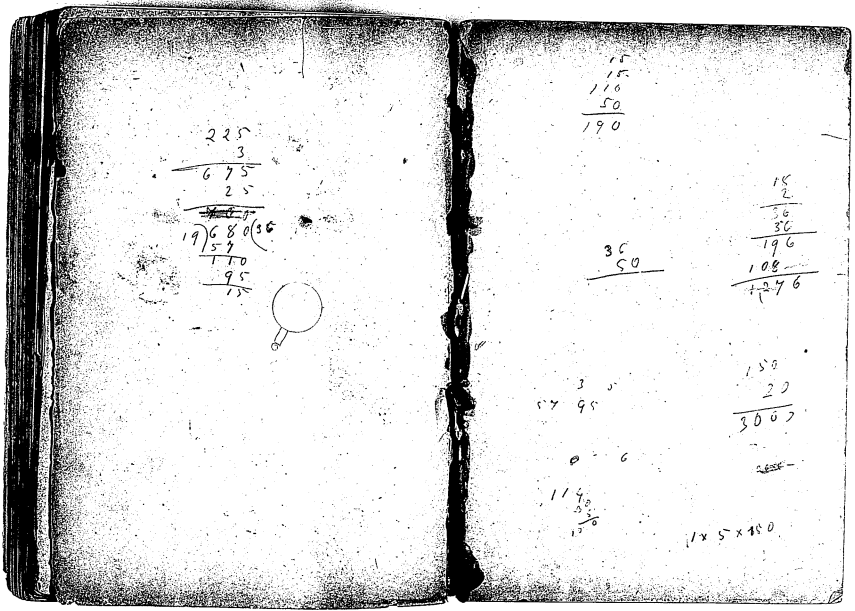
2586 | 33000 (12.
2586
7140
5172
19680


220 on lump
225 on 73.5









Menlo Park Notebook #27 [N-79-02-14]

There are no dated entries in this notebook with the exception of one entry for February 12 (no year). The book probably dates from 1879. Many of the entries are by Henry M. McIntire. There are also some entries by Edison. Most of the book consists of notes by McIntire on mixtures of metal sulphides and stannic sulphides. There are also miscellaneous calculations, possibly on meters, and notes by Edison on chemical experiments and on experiments to produce a coal-like residue from vegetable substances. The book was paginated twice, from the front to the back (pp. 1-142) and from the back to the front (pp. 1-284). In the first sequence, all of the left-hand pages are unnumbered.

Blank pages not filmed [first sequence]: 42-47, 72-76, 80-141.

No 27

450
5-5-60

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GENERAL ELECTRIC

_____, 189 6

Antimony Sb2S3
Arsenic, Dis- As5 Realgar, Red Orpiment
" Tri- As3S3 Orpiment
Bismuth, Dis- Bi2S3
" Tri- Bi2S3
Copper = Proto- Cu2S
" = Hemi- Cu4S
Iron - Proto- FeS.
" Magnetic, Fe3S4
" Disulph- FeS2
Potassium, Dis- K2S, Alkali
" Tetra
Sodium Dis
Tri-
Tin, Proto- SnS
" Disulph. SnS2
Zinc - sulphide
Ores Shows, sulphide

Mixtures of Sulphides

Equal Parts of

1 Sulphide " Antimony
" " Bismuth

2 " " Antimony
" " Cadmium

3 " " Antimony
" " Iron

4 " " Antimony
" " Potassium

5 " " Antimony
" " Sodium

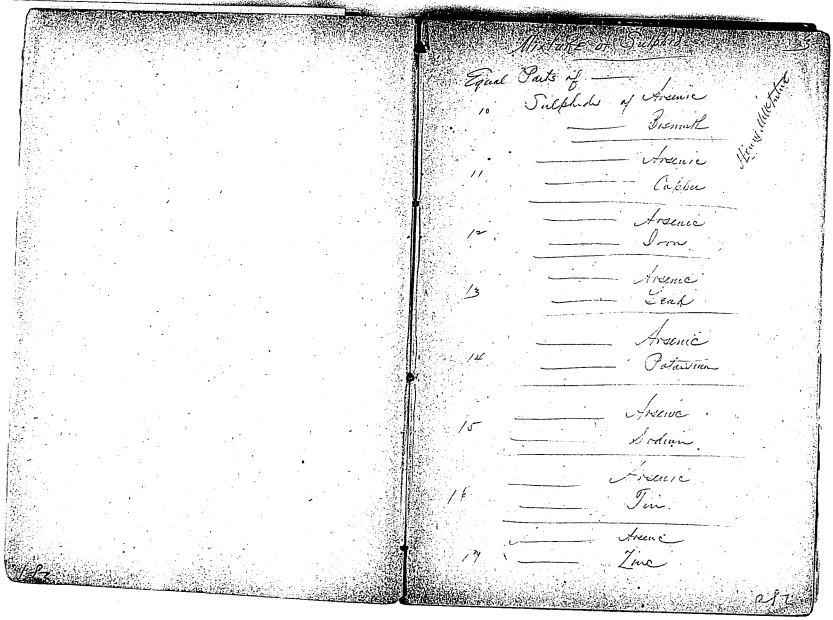
6 " " Antimony
" " Tin

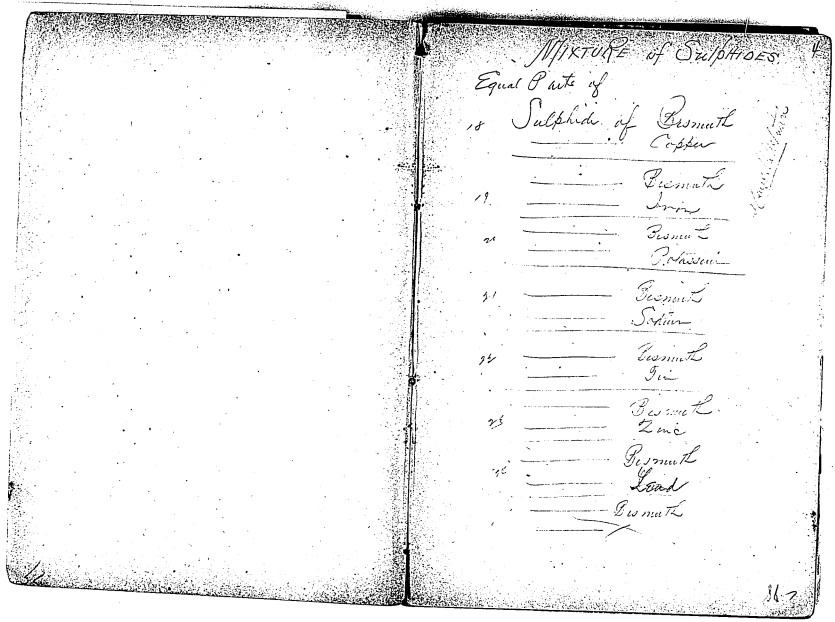
7 " " Antimony
" " Zinc

8 " " Antimony
" " Lead

9 " " Antimony
" " Arsenic

Mixtures of Chlorides


Mixture of Sulphides
Equal Parts of ——
10 Sulphides of Arsenic
—— Bismuth
11 —— Arsenic
—— Cobalt
12 —— Arsenic
—— Iron
13 —— Arsenic
—— Lead
14 —— Arsenic
—— Potassium
15 —— Arsenic
—— Sodium
16 —— Arsenic
—— Tin
17 —— Arsenic
—— Zinc
Hand Alteration


MIXTURE of SULPHIDES.

Equal Parts of

Sulphide of Bismuth
Copper

Bismuth
Iron

Bismuth
Potassium

Bismuth
Silver

Bismuth
Tin

Bismuth
Zinc

Bismuth
Lead

Bismuth

Mixture of Sulphides.

Equal Parts of —

25 Sulphide of Cobber
—— Iron

26 —— Cobber
—— Lead

27 —— Cobber
—— Potassium

28 —— Cobber
—— Sodium

29 —— Cobber
—— Tin

30 —— Cobber
—— Zinc

Newyork Mixture

MIXTURES of SULPHIDES

Equal Parts of

31 Sulphide of Iron
— Lead

32 — Iron
— Thorium

33 — Iron
— Sodium

34 — Iron
— Tin

35 — Iron
— Zinc

Engr. Mech. Lab

Mixtures of Sulphides

36 Equal Parts of
Sulphide of Lead
" Potassium

" " Lead
37 " " Sodium

" " Lead
38 " " Tin

" " Lead
39 " " Zinc

MIXTURES OF SULPHIDES

Henry Wurtz

Equal Parts of

No Sulphide of Potassium
" " Sodium

" " Potassium
41 " " Tin

" " Potassium
42 " " Zinc

MIXTURES OF SULPHIDES

Equal Parts of

45 Sulphide of Sodium
" " Zinc

40 " " "
" " Iron

45 Sulphide of ~~Sodium~~ Iron
" " Zinc

~~Sulphide of Iron~~

MIXTURES OF SULPHIDES

Equal Parts

Sulphide of Earthenware.
" " Antimony
" " Phosphorus
" " Arsenic
" " Phosphorus
" " Bismuth
" " Phosphorus
" " Iron
" " Phosphorus
" " Copper
" " Phosphorus
" " Lead
" " Phosphorus
" " Potassium
" " Phosphorus
" " Sodium
" " Tin
" " Phosphorus
" " Phosphorus
" " Zinc

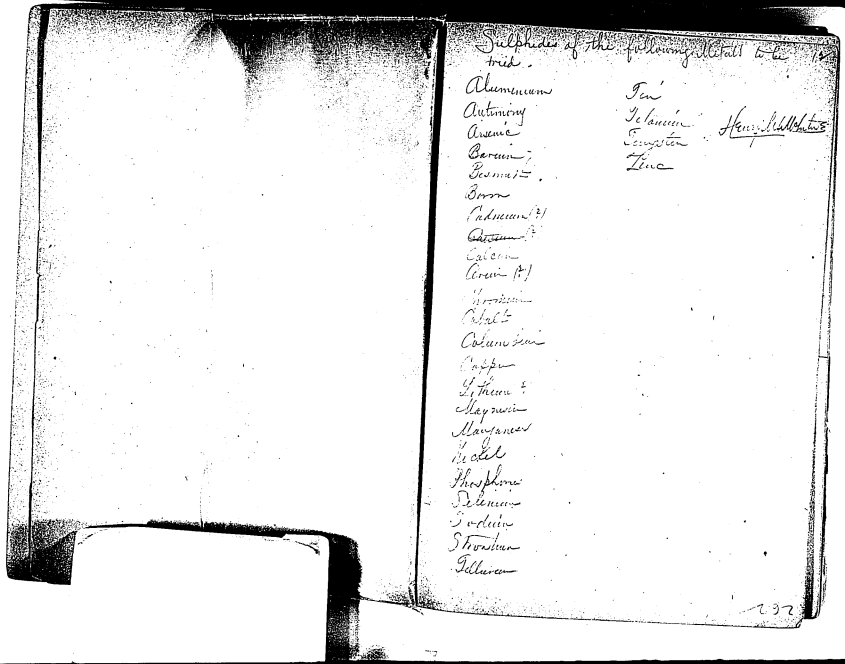
Stannic Sulphide. SnS_2 - To make.

1. Best chloride of tin + Sulphur (mix not work)
2. Eq. pts. of sifted tin filings. S + Nitq cc
3. 4 pts tin filings. 3 pts S, 4 pts S. 2 Nitq cc.
4. A pulverized amalgam of 12 pts Sn + 6 pts Hg. with 7 pts S, and 6 pts Hg Chl.
5. A pulverized amalgam of 12 pts Sn + 8 pts Hg mix 7 pts. S + 3 pts Hg Chl cc
6. 2 pts SnO_2 + 1 pt S
7. 8 pts SnO_2 + 4 pts S + 4 pts Nitq cc
8. 10 pts Sn S + 5 pts S - 4 pts Nitq cc
9. 5 pts Sn S + 1 pt $SnCl_2$ + 2 pts S
10. 5 pts Sn S + 8 pts Hg Cl cc

Either of these mixtures gently heated in retorts in a glass retort, or in a strongly curved flask, immersed in a sand bath. Vapors of mercury, sal ammoniac &c are thrown off, afterwards the excess of sulphur which the Stannic sulphide partly remains at the bottom of the vessel, and partly collects in the upper part of the retort, as a sublimate.

Watts, 3rd V 4 F23

X 9.2


Sulphates of the following Metals to be tried.

Aluminium
Antimony
Arsenic
Barium
Bismuth
Boron
Cadmium (2)
Caesium
Calcium
Cerium (4)
Chromium
Cobalt
Columbium
Copper
Glucinum
Manganese
Molybdenum
Nickel
Phosphorus
Selenium
Sodium
Strontium
Tellurium

Tin
Tolancium
Tungsten
Zinc

Henry McWhorter

Ppt. Stannic Sulphide

As to its forming. Mit Red Lamb

Heated a small portion in a Porcelain Crucible, until red. = de composed.

Heated a small portion in a Porcelain crucible not red. Ignited

Heated a small portion in a Porcelain Crucible not red. Ignited not continued long enough

Heated a small portion in a Crucible with Sol. Sulfid, to good.

Heated a portion in a Crucible with Sol. Sulfid on. (15 min). Not quite long enough

Repeated - (20 m.) - Not quite, by longer

Repeated - (25 m.) Ignited

Repeated - (30)

Heated with Sulphur, a Crucible (30 min.) Not long enough.

Heated a Crucible, (30 min) Not Fused

" " "

Stannic Sulphide. Hexachlorethane

To Fuse

In Hessian Crucible in Furnace,

Another sample above in Hessian crucible 10 minutes. Did came off. Fused

~~Heated Sample above in Hessian crucible~~ ~~10 minutes~~ However about half of it fused to a button scattered and remainder above, hard in some cases, as had parts of Reed. Did not know how long to let ~~me~~ off. Removed from fire as soon as observed.

Heated Sample in Hessian (Same heated) same as above for 10 minutes. Fused crucible is about same as above. For Furnace the Time = 20 minutes.

Stannic Sulphide

To Ferric — Hemisulphide & Iodine

Heated in Hessian Crucible 1gm as above 30 minutes. Fused mass, and but a small coating of black stuff (S) Dry Oxygen ferric

Heated in Hessian Crucible same as above with addition of small quantity of pulverized Sulphur Lid off 15 minutes, formed a slate gray mass, Dry mica mica

Heated in Hessian Crucible, above, Blowby, lid came off... Dry again

Heated in Hessian Crucible with Sulphur (less than before), 15 minutes Black mass, semifused, with light gray ash Dry Again with but trace of S

S. Faimic Sulphide

Heavy Lilac tint

Heated in Hessian Crucible, about 30 minutes

Most amount of fused crystalline mass. Dry crucible for another

Heated in a Hessian Crucible with a crust of Sulphur,

20 minutes

Some but a very small sulphur in the fume but a large amount of crystallines, and a large amount of black mass, also a few small crystalline [illegible] of sulphur crystals [illegible]

Sulphur - had a dry - small [illegible] of metallic Fe

Dry - Salt cover =

Brown fumes = microcosmic salts? Sodium carbonate = caustic soda. Potassium [illegible]

Stannic Sulphur

Henry Llewellyn Williams

SnS_2

1 of Tin and .5814 Sulphur

$Sn\,S + S = SnS_2$

$(\mathrm{M}2132) - 32 =$ ——

$144 \div 32 =$ ——

$1 + .2224 =$ ——

To MAKE

4 grms - Sn S } Mixed well.
.88 - S } Placed in Hessian
Crucible, and in fire, Luted Crucible
Crucible Water

Repeat }

Sublimed

Stannic Sulphide

Stannic Nitrate

Testing of

In Crucible, with salt cover.

Not Good

In crucible with broad cover
Quite good shelter

In Cruc with microcosmic salt.
Lit flowers of

do. with Sodium Carbonate
Not Good

do with Potassic Cyanide
Very good. Very vigour, and comfort
with broad Cy, testing, equal weights of
Sn & and weigh & reading shelters, with
Vigour Very Equal

Stannic Sulphate

J. Chem. Soc. Vol. Page

To Make.

Dried, 5 to 5 over Bunsen flame, fused, ½ g. stamped to dirty, blackish yellow. Button apparently unalloyed. Put back in crucible & heated again two times over blast lamp. Hammered

Altered

Fused in Berlin crucible with some cover over Bunsen flame, put back over a Blast lamp, quite some heating found several bunches of crystals of the Nitride, after the fusion and at the bottom a solid layer of the Nitride & Sulphide, in lamellae, resembling to a great extent graphite, would mark Lab

Stannic Sulphide

Stannic Sulphide

To Flask

Fused 4 gms Sn. 2.38 gms Sulphur
in crucible over Blowpipe burner
Found mass all changed to
black sulphide

Fused Sn S + S over Bunsen & Flask
Lamp - Strong a sublimation in top of Crucible
in flask, brass Crucible cover, slight Sulphur odour in
flask, some brownish yellow of Sn S, and in the
Crucible a veined crystalline mass of Sn S Tray
Equal weights of S + Sn

Fused Sn S + S + Borax Glass over Blast Lamp
Found a black slag, and a [illegible]
of Sn S sulphide + Sn

Fused Sn S + S + K2 CO3 over Blast Lamp
Results of Sn S black, no slag

Fused Sn S + S (equal weights)
Small sublimate of Sn S

Stannic Sulphide

Henry Cubbon's

Fract. SnS_2 + S_2 H_2O Cl, over Blast Lamp
Practically an almost Change to
SnS_2 in Cocoa, Cooled, re-ran over
and put back. Still larger deposit
only a small remainder of Stannic
Sulphide

Stannous Sulphide and Sodic Sulphide

No good

Fract SnS_2 + S_2 H_2O Cl over Blast Lamp
Practically no good equal to the
previous one. The crucible used was
much larger, consequently more Silica
for a considerable portion of the time

Fract SnS_2 + S_2 H_2O Cl,
Slight amount formed, try again with
less Sulphur

AAZ

Steam Sulphide

Henry Wilkinson

Fused a Crucible over Bunsen-lamp with
3 gms. FeS, 3 gms. S 15 Hour
Pour. Pour. Pour

Fused FeS + S in Hessian Cl, in a
Crucible but most completely Failed
Got a yield, although fused mass
is smaller than Sulphide & Matter,
Fine Particles, Probably of
Chromate and Carbon

Fused FeS + S in Hessian Crucible over Bunsen Burner,
Very fine Yield, then a pan Cutter Run Off
in sub. but over Bunsen Blast
Cooled, Double Heat

Fused. - 5gms. FeS + 2.5 S + 2. Hour -
Slip Slip,
A small amount of unaltered Sulphide
a Cutter

Stannic Sulphide
Hemihedrism

Trig 5 gnw Sw + 2 S + 4 NH4 Cl
Nat Tetragonal

Tetrag 5 gnw Sn S + 2 S + 1 NH4 Cl
Nat very good Try metal with
NH4 Cl

Trigd 5 gnw Sn S + 2 S + 2 NH4 Cl
Nat very good, try again

Tetrahs 5 gnw Sn S + H2S + 2 NH4 Cl

Try 5 gnw Sn S + 2 S + 2 NH4 Cl

Stannic Sulphide

Hempel's Method

Mix
Intimately 1 mixture 0.9 gm. S.S. + 2½ gms + 2 gms Iodine
in a long glass tube closed at
lower end and capped with perman-
ganic crucible, placed on sand bath and
heated slowly,

Fused mass runs as a shiny black
at one end, and collects under
crucible, and heated strongly by Bunsen
burner.

Found at bottom, a mixture of
black + yellow Sulphides, above
a deposit of White Cl + greenish yellow
Sulphur, and above that Iodine

JSR

Stannic Sulphide

Stannic Sulphate

Fused in Berlin Porcelain crucible 5 gms Sn 5 gms S 2½ gms Na2CO3 Cooled and heated directly over Bunsen Burner.

Found it pretty completely changed to Stannic Sulphide. Of this took 3 gms and added 1 gm. Sulphur and 1 gm. Ammonic Chloride mixed well, placed in Porcelain crucible, heated slow and placed over Bunsen Lamp

Used 2.5 gms Sulphur on bottom of crucible, above it an intimate mixture of 5 gms Sn S and 2 gms NH_4Cl in a Porcelain crucible over Bunsen Lamp

Not at all good

Stannic Sulphide

Hemplemann's solution

Fused in crucible, 5 gms SnS_2 + 3 gms S, + 2 gms. Nitrate, fine fused. over Bunsen Burner.

Pulverized. Repeated and gave more heat & repeated with Bunsen, and more with blast, Try also 2 gms Sulphur, with Bunsen and with blast, Try 2.5 gms Sulphur, with Bunsen and, more Blast

Stannic Sulphide.
Harold McIntire

Tried in Crucible (#1), 5 gms. SnS_2 + 3 gms S + 2 gms NH_4Cl, over Bunsen. Yield about as usual. Unusual share of sublimate available in first part of the crucible that was covered with most heat

Tried in Crucible (#2) 5 gms SnS_2 + 3 gms S + 2 gms NH_4Cl over blast. Yield of SnS_2 about and Fe_2S_3 about as formed mass, by one run between and then over blast

Tried in crucible (#3) 5 gms SnS_2 + 3 gms S + 2 gms NH_4Cl, over Bunsen. Lustre better than ~~any~~ altho the same was recommended Zero may be observed, Scrape this off and try it with heat, three of more evenly distributed heat would do any better

257

2 : 4

1 : 4 :: 9 : X

36

2 : 4 :: 9 : 18

2

4 | 18

4 3/4

4 | 12 6

3 1/2

3

4 | 22 20

5 - 5 -

3

5 4 1/2

112 | 10 2 | 155 | 16 5 -

9 1 5 -

1 5 - 1 -

4 | 2 2 6

5 6 5 -

3

196 | 169 5 -

186

1 9 5 -

Stannic Sulphide

Henry M. McIntire

Fried in Crucible (#3) .5gms. Sn.S + 2.5 S + 2 Nitric Cl on Burner

Fried in crucible (#4) .5gms Sn.S + 2.5gms S + 2 Nitric Cl over blast. Puts very small yield Hexagonal plates as #2. Seems to indicate that the amount of S should vary with the heat. Try with #3 S + 2 Nitric Cl. also #5 + Nitric Cl

Fried in crucible (#5) .5gms Sn.S + 2gms S + 2 Nitric Cl over burner, placed in a larger crucible, the interspace being filled with sand. Yield not near as good but much more uniform.

Fried in crucible (#6) .5gms Sn.S + 2gms S + 2 N H Cl over blast

Pretty fair. Lots of great amount of Sn S deposited

Stannic Sulphide

Heavy White Powder

Treated SnS - 5gms, S 4gms, + $KClO_3$ 2gms placed in ~~small Sand bath over Burner~~ ~~and~~ over Burner

Same

Unremarkable.

Treated SnS 5gms, S 2.5gms, $KClO_3$ 2gms. placed in small Sand bath and over Bunsen Burner,

About as usual.

Jorg. "to reduce Stannic Sulphate by C.

- to form SnS_2 by passing H_2S over hot tin
- to form SnS_2 by $SnCl_4 + S$
- " " " " by passing H_2S over SnO

Stannic Sulphide

Heavy black precipitate

Tried 1 of Sn. 1 of S. 1 of NH_4Cl. well mixed, and heated very small quantity between coals

Tried 4 of Sn. 3 of S. 2 of NH_4Cl.
Smaller specks, quality about the same

Tried Equal weights of $SnCl_2$ and S.
BARG up.
Completely transformed.
Major part sublimed off S.

$5.9\ SnCl_2 + 1S =$
$2.2\ SnCl_2 + 1\ Sn.$

Tried. $SnCl_2$. Sgm. 1S
Most of it converted although there seems to be a little $SnCl_2$
Weight of product 1.8
Theoretical yield 2.4

Stannic Sulphide
Hemisulphide Stannic

Used 5gms Sn Cl$_4$, 4gms S
Mixed well & covered & charged as before
Seems to be a better charge
Weight of product = 1,8

Theoretical yield of SnS$_2$ from 5gms Sn Cl$_4$ = 2.4gms

Used 5gms Sn Cl$_4$ 2gms S.
Better than preceding,
Weight of yield 2,2

Used 5gms Sn Cl$_4$ 3 gms S
About the same, perhaps
a little better,
Weight of product 2.2
(for a better charge)

Used 5gms Sn Cl$_4$ 4gms S
Better still.
Yield — 4.4 Sulphur not bonded strongly
Try again

272

Stannic Sulphide

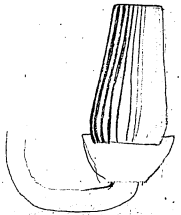
Heated till Sulphur all off

Treated 5 gms Sn Cl4 + 5 gms S
Reddish-brown
yield 4.93 gms when all off

Treated 4 gms Sn Cl4 + 5 gms
Partly reduced to black Sulphide,
Heated to high but not long.

Treated 3 gms Sn Cl4 + 5 gms S
Almost completely to
black Sulphide

Treated 2 gms Sn Cl4 + 5 gms S



Stannic Sulphide

Henry M. Stanton

Treat 1 gm Sulphate 5 gms S.

Treat 5 gms Sulphate + 4 gms S.
Least hot on bottom, black.

Treat 5 gms Sulphate + 5 gms S
Good, a little black, and sulphur
rotten if at top.

Treat 5 gms Sulphate + 3 gms S.

VERY

GOOD

Stannic Sulphide
Spurgite Waterite

3

Fried 5 gms $SnCl_4$ + 2 gms S.
Grey. Some chloride, and some black sulphide

Fried 5 gms $SnCl_4$ + 1 gm S.
Very good altho' a small amount of sulphur, and a little chloride

Fried 5 gms $SnCl_4$ + 1.5 gms Sulphur
Found Trace of Sulphide

Fried 5 gms $SnCl_4$ + 1.5 gms Sulphur
Found Trace of sulphide,
Powdered and put over Bar Flame
Found trace creation of sulphide
and better black sulphide

L/C

912

Stannic Sulphide

Having Sn Cl of standard

Fused 5 gms Sn Cl and 1.5 gms S, Iron Blast, 1/2 sulphur, Bottom Flaked Sulphide

Fused 5 gms Sn Cl 1.5 gms S. Started at all mass. Dissolves but 5 ems chlorides.

Fused 5 gms Sn Cl + 2 gms S. The sulphur being placed in bottom and the Sn Cl above it. Good at bottom (but the Chloride) Sulphide at top, big mistake less S.

Fused 5 gms Sn Cl + 1 gms S. at bottom. Still sulphurous smell, Troy ounce Sn S — 1/2

Fused 5 gms Sn Cl, 5 gms S, the Sulphur being at bottom. Stonecat. See much Sulphur. Try again with 2 gms S. A dark colored mass

Stannic Sulphide

Henry Mellor Archive

Fried. Sn Cl$_2$ (5gms) + S (2gms) Stannic Sulphide being at top and heat applied about half way up the side of crucible.

No good

Fried. Sn Cl$_4$ (5gms) S. 2gms. Sulphur being in bulbs of crucible; Stannic Sulphide about 1". Very quiet heat. Removed. Grunt barley sweet. Neutral atmosphere heat.

Quite Good

Dry Sn O$_2$ + S + NH$_4$ Cl.

Fried. Sn Cl$_2$. 5gms. S. 2gms NH$_4$ Cl. 2gms. very good, fat back and heated hydrous

Fried. Sn Cl$_4$ (5gms) S (2gms) and heated slowly, effect: Nitrous Oxide

Not good for something

Fried Sn Cl$_4$ (5gms) S (2gms) NH$_4$ Cl (2gms) - heated

Up set.

Herman M. McIntire

Tried 5 fms Sidle. 2 fms S and 2 fms Witte CC
Removed from fms rec they could not the
last and returned the rest to ensemble theatre

Tried Sido + S

~~Wm. H. JAMES~~ RE

Tried 3 fms Sidle, 3 fms S. 3 fms Witte CC.
VERY Good

NOTE. EXAMINED Some of earthy looking Bottoms subj microscope and found # Diat in Sid. in a finely divided State Examined mud the very most Diat found

163

216

Sarum Sulphide
Henry Hutchinson

Ind Sulph 5. Sx.
Very Faint,

Ind Sulph 5. S=1
Very good

Ind Sulph (5gms) S(2gms) N.H.O.(2gms)
Absent as usual

Stannic Sulphide

Henry M. McWhorter

To Fuse.

Fused some small pieces crucible in furnace, very hot fire — 11 min, 10,20
Let cool off. all crystalline 8.50

Ditto — Ditto Ditto Ditto Ditto
Same material found nothing but black 11.20
Sulphide

Ditto Ditto Ditto Ditto Ditto Ditto Ditto Ditto Ditto
Nothing but Black Sulphide 11.20 11.47

Ditto Ditto Ditto Ditto Ditto Ditto Ditto Ditto Ditto
Nothing but Black Sulphide 11.47 11.12

Do. Do. Do. Do. Do. Do. Do. Do. Do. Do.
Nothing but Black Sulphide 11.20
Try more of the stuff and look for and Amorphous

Lac

Francis Scott Key
Henry Middleton
1855

Francis Scott Key Legation,

24) 3·86 (.0119
24
14
21
220
216

21) .0685 (.0032
63
55
42
130
126

21) .0632 (.0031
63
22.0
21
1.0,0

21) .0675 (.0032
63
45
42

60) 1.00 (.00
.000 [illegible]

.0320 (.0005
310

Weighing to be done

~~Grand b, 7.45 Pcs.~~

~~Grand f, 10, 11, 12, 13, 14, 15 = 12.000.~~

~~7, 8, 9 = 8.30 Pcs.~~

~~1, 2, 3, 4, 5, 12.00.~~

~~a, b, c, 3.350. Pcs.~~

a = 5.1178
b = 5.3552
c = 5.0855

~~5.1678~~
1.1355
4.
24
56

~~8.115 Pcs.~~

f = 14.1336
h = 14.3372

7 = 14.4950
8 = 14.2236
9 = 3.791

~~8.30~~

1 = 15.2350
1 = 13.4887
2 = 15.9460
2 = 14.2911
3 = 15.7138
3 = 15.3330

1 = 28.430 -
2 = 29.245 +
3 = 27.868
10 = 10.3110
11 = 25.533
12 = 8.2000 +
13 = 7.6031
14 = 4.1076
15 = 9.2268
d = 18.3556
e = 4.0988 +
f = 5.6955 +

18.392
18.359
.033

4.714
4.698 +
.016 -

5.707
5.698 +
.012

18.407
18.392
.015

4.720
4.714
.006

5.713
5.707
1.006

~~12.30 Pcs.~~

18.771
18.716
.055

4.795
4.774
.021

5.772
5.749 5
.0225

Surface oxidizes very much

6.196
6.178
.018

5.376
5.352
.024

6.113
5.085
.1028

24
31.185
27.225
3.96
24
96
96
0

21) 96 (4.57
84
120
105
150
147
3

5.396
5.196
.200

98) 210 (219
196
140
98
420

1.74 = 1.74

5.208
5.196
43) .0120 (.279
86
340
301
390
387
3

5.220
5.208
72) .1120 (1.66
72
480
432
48.0

15.250 = 15.262 - x - 7
13.487 = 13.488 + x - 7
1.763 = 1.774 - 2x
1.763
2x = .011
x = .0055

15.996 = 16.007 - x - 7
14.201 = 14.206 + x - 7
1.795 = 1.801 - 2x
1.795
2x = .006
= .003

15.738 = 15.749 - x - 7
15.330 = 15.333 + x - 7
.408 = .396 - 2x
.012 = 2x
x = .006

15.250 15.262
13.487 13.488
28.737 28.750
28.737
.013

15.996 16.007 15.738 15.749
14.201 14.206 15.330 15.333
30.197 30.213 31.068 31.082
30.197 31.068
.016 .014

14,458 / 29,871 / 29,845 / ,023

14,161 / 29,845

13,860 / 14,925 / 28,785 / 28,763 / ,022

15,200 / 13,563 / 28,763

13,867 / 14,440 / 30,337 / 30,312 / ,025

14,145 / 30,312

1 = 28,405 − 1.50 RU. 7th
2 = 29,998 − 1.55
3 = 27,848 − 2
4 = 10,978 − 2.05
5 = 5.540 − 2.10
6 = 3.188 − 2.15
7 = 1.620 − 2.20
8 = 4.064 − 2.25
9 = 2.261 − 2.30
a = 18.335 − 2.35
c = 4.685 − 2.40
f = 5.685 − 2.45

a = 5.169 − 3.30
b = 5.338 − 3.35
c = 5.071 − 3.40

S-29

q = 14.121 − 7.45 RU.
h = 14365 − 7.50

7 = 14.422 − 8.30 RU.
8 = 7.217 − 8.35
9 = 3.768 − 8.40

7,631 / 7,620 / ,021

11.310 / 10,978 / ,132

14,456 / 14,422 / ,028

4.076 / 4.067 / ,009

5.5-5-5-5 / 5.5-40 / ,015

7,236 / 7,217 / ,019

2,268 / 2,261 / ,007

3.200 / 3.188 / ,012

3.791 / 3.768 / ,023

5.178 / 5.169 / ,009

5.352 / 5.338 / ,014

5.085 / 5.071 / ,014

14,136 / 14,121 / ,014

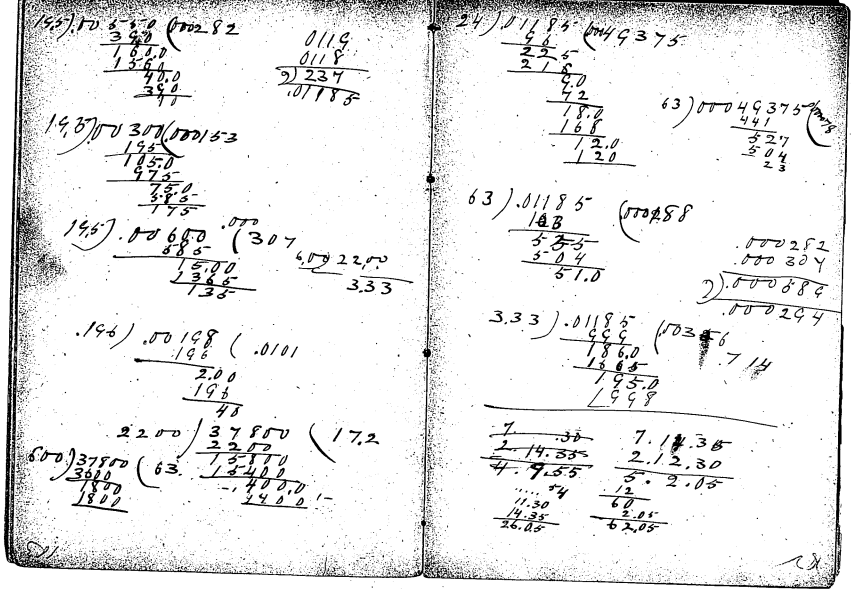
14,372 / 14,365 / ,007

18.359 / 18.335 / ,024

4.698 / 4.685 / ,013

5.696 / 5.686 / ,010

X 51



Resistance of coil = 2 Volts
Divide volts by resistance in
wat, and the quotient will
be the amount in Webers
which pass

$$\frac{V}{R} = W$$

.002

.002 : 1 :: 2.31 : X

(.002) 2.31 (1155
2
3
2
11
10
10
1.0

7.15.30
2.15.30
5.0.0
12
60

7.19.45
2.20.15
11.23.30
12
11
23.30
11.30

1 = 28.391 − 1.30 adjusted
2 = 29.211 − 1.25
3 = 27.829 + 2.
10 = 10.267
11 = 5.527
12 = 3.178
13 = 7.613
14 = 4.061
15 = 2.255

adjusted
clear
"

15.336 = 15.336 + x - 4
15.193 = 15.149 - x - 4
.142 = .188 + 2x

15.336 = 15.336 + x - 4
15.147 = 15.193 - x - 4
.188 = .142 + 2x
.046 = 2x
x = .023

15.462 = 15.458 + x - 4
14.844 = 14.799 - x - 4
.618 = .659
15.462 = 15.458 + x - 4
14.799 = 14.847 - x - 4
.683 = .611 + 2x
.072 = 2x
x = .036

15.458 = 15.462 + x - 4
14.799 = 14.847 - x - 4
.659 = .615 + 2x
.044 = 2x
x = .022

14.923 = 14.969 - x - 4
15.243 = 15.202 + x - 4
.318 = .283 + 2x
.035 = 2x
x = .017

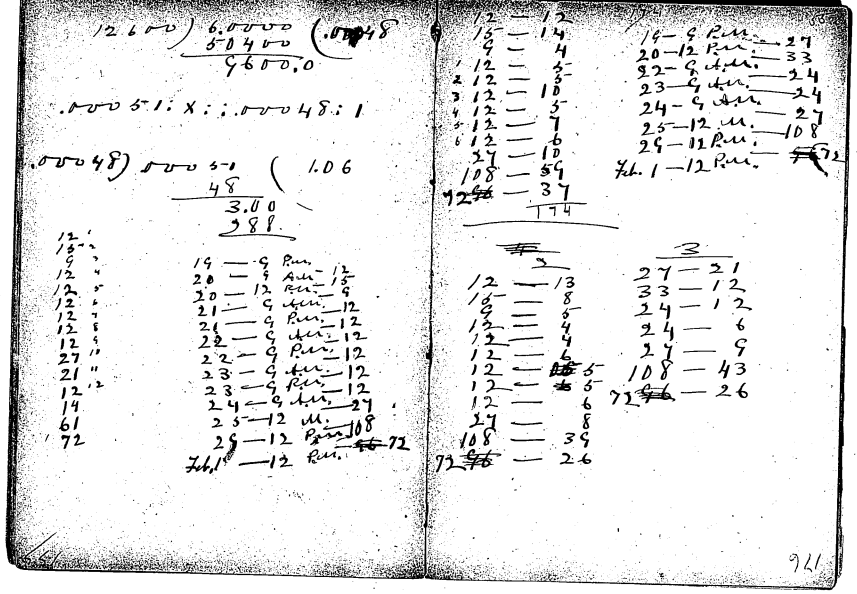
11.410 = 11.421 + x - 4
11.313 = 11.365 - x - 4
.097 = .056 + 2x
.041 = 2x
x = .020

11.918 = 11.969 + x - 4
11.408 = 11.413 + x - 4
.510 = .556 - 2x
.510
.046 = 2x
x = .023

20
23
23
22
4)88
43) .02220 (.0005+
215
.0070
43
27

.0005 = 1 gram per hour

7
30
6
43



19 — 9 P.M. — 27 — 28
20 — 12 P.M. — 33 — 14
22 — 9 A.M. — 24 — 13
23 — 9 A.M. — 24 — 9
24 — 9 A.M. — 27 — 10
25 — 12 M. — 108 — 52
29 — 12 P.M. — [illegible] — 34
Feb. 1 — 12 P.M.

19 — 9 P.M. — 96 — 28 — 24 — 144
23 — 9 P.M. — 147 — 14 — 4 — 3
29 — 12 P.M. — ~~96~~ 72 — 147
Feb. 1 — 12 P.M.

22.11
20.15
1.20

2 1/16 × 1/32

572) 1089 (2 — 126
1024
650
572
780
572
208.0

1380
1024
3560
3432
128.0

488.0

713 — 400 — 392 — 387 — 383
400 — 392 — 387 — 383
13 — 8 — 5 — 4

383 — 379 — 373 — 368 — 363
379 — 373 — 368 — 363
4 — 6 — 05 — 5

368 — 367 — 349 — 310
357 — 348 — 310 — 284
6 — 8 — 39 — 26

1030 — 1009 — 997 — 985 — 973
1009 — 997 — 985 — 973
21 — 12 — 12 — 6

979 — 970 — 927
970 — 927 — 901
9 — 43 — 26

126 — 096 — 082 — 069 — 060 — 050
096 — 082 — 069 — 060 — 050
29 — 14 — 13 — 9 — 10

080 — 998
998 — 964
82 — 34

33/16 × 33/32
33
55
33
1089
512

33
32
66
99
1056
512

377 Mllgr

104 | 22.60 | 217
208
182
104
780

21.7 Mllgr in a Record Daniells on Ohm

108 | 21.7 | 20.6
216
100

20. Mllgr per Weber per second

20 Mllgr

252 | 5-5-7 | 2176
5-12
450
216
1554.0
1512
1380
1512.6

1250.

C41

16.167
15.887
.280

15.687
15.413
.274

15.200
14.925
.275
18

207
145
62

749
687
62

+808

12 5-
20 60
65

33
17
221
33
5-5-1

15.333-
11
15.324

15.333-
15.333-
17
8
33
32
8
256

1 1/32 x 2 1/8

21.708

2nd 1.843

6,30

261

1 = 25,370 — 7.50 — Sl. of weight
2 = 25,185 — 7,05 — smudge
3 = 27,802 — 7,00 — clear
7 = 14,377 — 7,15
8 = 7,184 — 7,25 — Sl.
9 = 3,750 — 7,30 — slightly Sl.
10 = 10,237 — 7,40 — clear
11 = 5,507 — 7,45 — "
12 = 3,163 — 7,50 — "
13 = 7,604 — 9 — Sl.
14 = 4,049 — 9,05 — clear
15 = 2,246 — 9,10 — "
a = 5,145 — 9,15 — "
b = 5,309 — 9,20 — "
c = 8,042 — 9,25 — "
d = 18,288 — 9,30 — slightly Sl.
e = 4,653 — 9,35 — clear
f = 5,870 — 9,40 — Sl.
g = 14,082 — 9,45 — clear
h = 14,327 — 9,50 — "

Feb. 12

241

.0282
.0304
.0586
.0299

22.00 / 6.0000 (.0024 Wilson
44.00
16.0,0
14.00

1 : x :: 295 : 27.00

.11 (.0027) .0295
27
25
27

9/1000 (6.0000
3750
2250,0
2268 00

1 : 1900 : x : 3150.00

1.87 (5.8200 (91.00
16
138
125
132

15
24
43

1- 12 - 19 - 00
7 - 13 - 30
5 - 5 - 10 = 125.10

7 12 - 19. 15
7. 20. 30
4 - 22 - 45 = 119.45
24
96

13 12 - 21 - 00
7 - 14 - 20
5 - 6 . 40 = 126.40

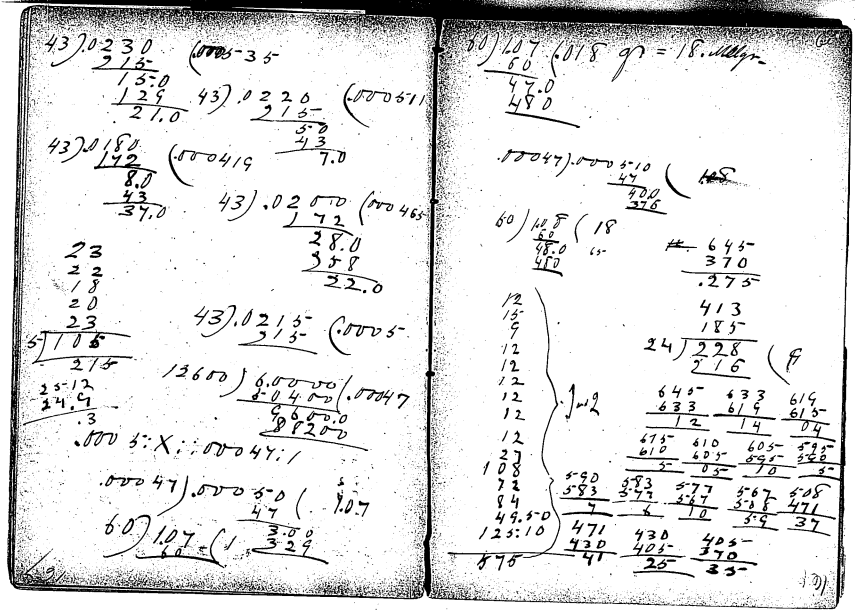
19.3
60
1170

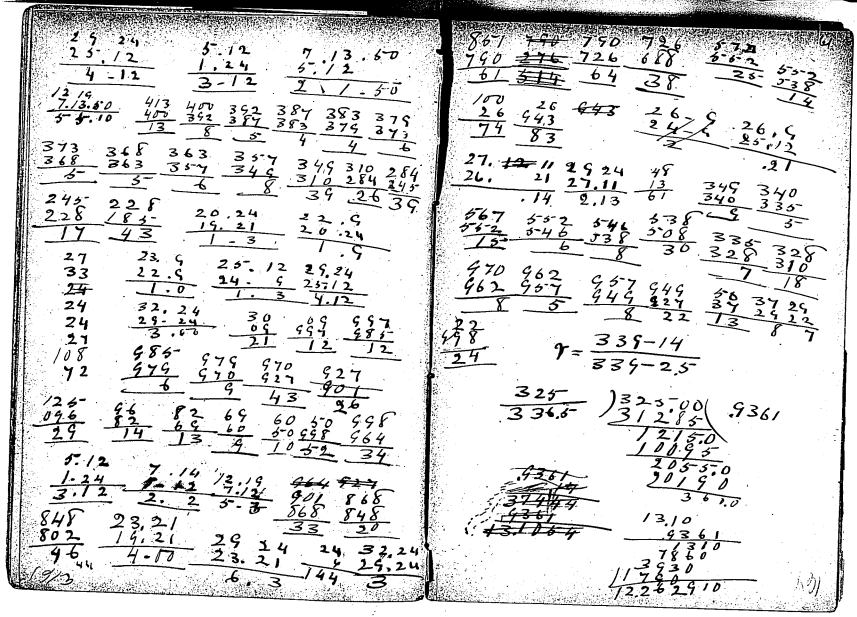
a - 12 - 21 - 13
7 - 15 - 30
5 - 5 . 45
24
120+5 + 45 = 125.45

d 12 - 21 - 30
7 - 14 - 35
5 - 6 - 5 - 5
126 - 5 - 5

g 12. 21 - 45
7. 19 - 45
5 - 2 - 00
122 -

32.24
29.24
3 . 00
24
72





17.11.35
12.19.
4.15.35

17.11.45
12.21.
4.14.45

17.11.15
12.19.40
4.15.35

17.12
12.19.15
4.16.45

15.462
14.847
.615

15.488
14.745
.659

15.333
15.193
.140

15.335
15.147
.188
.142
.46

15.193
15.147
.46

Plates 3 X 1½

15.2462
14.9469
.2993

15.243
14.925
318
283
35

15.335 = 15.335 + X - 4
15.147 = 15.193 - X - 4
30.482 = 30.528 - 24
30.482
24 = .046
1 = .0023

15.335 = 15.335 + X .0023
15.147 = 15.193 - X .0023

1=28.33.3	10.30	clear	Slight
2=29144	10,40	"	clear
3=27766	10.45	"	Dt
7=14,361	10,50	"	Slightly
8= 7,142	10.55	"	"
9= 3.724	11-	"	"
10=10,197	11.15	"	clear
11= 5.476	11.20	"	Slightly
12=3,143	11.25	"	"
13=7.590	11.45	"	Dt
14=4.034	11.50	"	Slightly
15=2,233	11.55	"	"
a=5.128	12 Bell	"	"
b=5.288	12.05 Bell	"	Clear
c=5.018	12.10	"	Slightly
d=18.270	12.15	"	Dt
e=4.655	12.20	"	clear
f=1.658	12.25	"	Dt
h=14.299	12.30	"	Slightly Dt

17-

15.252
14.464
30.227
30.168
.053

16.243
14.928-
30.[redacted]

11421
11.365-
22.786
22.723
.063

11.410
11.313
22.723

15.462
14.847
30.309
30.257
.052

15.458
14.799
30.257

11.969
11.413
23.382
23.326
.056

11.918
11.408
23.326

15.335-
15.153
30.488
30.482
.046

15.336-
15.147

11.410 = 11.421 + x - 4
11.313 = 11.365 - x - 4
22.723 = 22.786 - 24
22.723
= .063

15.243
.018
15.225+4
15.25-2
.027

14.925-
.018
14.943
14.464
.029

No. 3

11.410
.020
11.390+4
11.421
.031

11.313
.020
11.333+4
11.365-
.032

No. 4

11.408
.023
11.385+4
11.413
.028

11.918
.023
11.941+4
11.969
.028

No 5-

15.335-
.023
15.312+4
15.335-
.023

15.147
.023
15.170+4
15.193
.023

No. 1

15.465-8
.022
15.436+4
15.462
.026

14.799
.022
14.821+4
14.847
.026

No. 2

15.336-
.023
15.358

15.193
.023
15.170

No. 1

.123
.022
.018
.020
.023
.106
.022

15.335
.023
15.358

15.193
.023
15.170
15.147
.023

No. 1

15.462
.022
15.484
.458
.026

14.847
.022
.825
.799
.026

No. 2

15.252
.018
.270
.243
.027

14.969
.018
.951
.925
.026

No. 3

11.421
.020
.441
.410
.031

11.365
.020
.345
.313
.032

No 4

11.469
.023
.948
.938
.028

11.413
.023
.436
.408
.028

No 5

15.252
.032
15.274

14.969
.022
14.947

15-252
14.969
.283

15.243
14.925
.318
.283
.035

No. 3

11.969
11.413
.858

5-5-6
510
.046

No. 5

11.969
.022
11.947

11.413
.022
11.435

11.969
11.413
11.35-6
.512
44

11.947
11.435
.512

15.462
14.847
.615

15.462
14.847
.615

No. 2

11.421
11.365
.056

11.410
11.313
.097
.056
.041

No 4.

3.51

Average loss = 23, 26, 26, 31, 28 → 134 ÷ 5 = 27

27 in 72 hours from surface 9–

Jan 28 – 11.05 P.M.

31

24) 72 (3
72

9
11
11
11
11
12
65

14.218
14.154
.064
14.462
14433
.029

31. 19.30
28. 23.05
2. 20.25
24
48+20=68

29 loss in 69 hours from surface 9–

g = 14.218 h = 14.462

14.218
14.082
.136

g = 14.082 h = 14.327

14.462
14 327
.135

d = 18.771; " = 18.270; .501

e = 4.795; " = 4.655; .140; 4; 5.60

f = 5.772; " = 5.658; .114; 4; 456; 456; 2516; 508

3 : 12 :: x :

40) 627.5 (25.1
4
227
200
275
275
0

5.01
251
5.01

95.05
2510.01
12 75.80
6 2.45.0
240
5.0
40) 225 (5
200
25
40) 1250 (31
120
50
480) 3150 (6
2880
270
480) 4320 (9
4320
0

15

3.12 : K;

5.220 − 5.128 = .092

5.255 − 5.288 = .111

5.140 − 5.018 = .122

7 14.587 − 14.361 = .226 — 113

8 7.328 − 7.142 = .186

8 3.860 − 3.724 = .136

11 10.417 − 10.197 = .220 — 110

" 5.631 − 5.476 = .156

12 3.260 − 3.143 = .117

13 7.716 − 7.590 = .126 — .063

14 4.136 − 4.034 = .102

15 2.311 − 2.235 = .076

1 28.643 − 28.333 = .312 — 267 — 45

2 29.413 − 29.144 = .269

3 28.030 − 27.766 = .264

18.771 − 18.335 = .436

4.785 − 4.685 = .110

5.772 − 5.685 = .087

18.771 − 18.359 = .412

4.785 − 4.688 = .097

5.772 − 5.695 = .077

18.771 − 18.716 = .055

4.795 − 4.774 = .021

5.772 − 5.745 = .023

18.407 − 18.359 = .048

4.720 − 4.698 = .022

5.713 − 5.695 = .018

18.407 − 18.270 = .137

4.720 − 4.695 = .065 — 2 — .130

5.713 − 5.695 = .065 — 2 — .110

18.771 − 18

4.795 − 5.772

4652 (68

26

1305 1052

1124

68

560

84

137 × 137 = 5 5 5 — 411 — 137 — 18765 — 3 — 25.6307 — 4652

K51

24.14.30
17.18.35-
7.3.55-

24.14.50
17.10.10-
7.4

24
188+3 = 171.55-

24.15-.05-
17.11.15-
7.3.50

24.15-.20
17 11.45-
7.3.35-

24,15-.41-
17.12
7.3.41-

28.333
28.295-
.038

29,144
29,137
.007

27.766
27.718
.048

14,361
14,320
.041

7,142
7,111
.031

3,724
3,692
.032

10.157
10.134
.067

5.476
5.440
.036

7.50
7.46
.034

3,143
3,116
.027

4.034
4.014
.020

2.235-
2.218
.017

1=28.295- 2.30 P.M. OK-
2=29,137 2.35- " OK-
3=27,718 2.40 " Really
7=4,3.20 2.50 " 8-
8=7,111 2.55- " Can't see
9=3,692 3, " " "
10=10,173 3.05- " " "
11=5,444 3.10 " " "
12=3,116 3.15- " " "
13=7.566 3,20 " OK-
14=3.04 3.25- " "
15=2.118 3.30 " "
a=3,113 3.45- " OK-
b=5.235-6 3.50 " Clear
c=4,987 3.55- " "
d=18233 4, " OK-
e=4,610 4.05- " Clear
f=5.634 4.10 " OK-
h=14.277 4.15- " OK-

24

2 4, 25 15-
1 5, 21 15-

6
24
120

March 4, 1880
12.30 Am.

~~Cu SO4, Sp gr. 1.2+, 7.75° F~~
~~Large plate 2 x 2, and 2 x 1, small 1/2 x 1/2~~
~~" " " " "~~
~~1 to 3 in 200 c.c. solution~~
~~2, 17, 4, 5, 6, 7, 8, 9~~
~~Cu SO4 from a different stock~~
~~if softer than the others~~
~~became hard after use~~
~~for all the plates~~

~~Cu(NH4)2(SO4)2 Sp. gr. 1.14, 7.75° F.~~

3) 772
25-7 | 330 (12
27
720
3
240

12, 3, 15, 17, 45 = 2 x 2 in 200 c.c.
4, 5, 6, 7, 8, 9, = 2 x 1 in 200 c.c.
78 c.c. = 2 x 1/2 in " "
10, 11, 12 = 2 x 1 in 100 c.c.
13, 14, 15- = 2 x 1/2 in 50 c.c.

1. 12.30
2. 12.35
3. 12.40
16. 12.45
17. 12.50
18. 12.55

Cu SO4
Cu(NH4)2(SO4)2

4.
5. 1.05
6. 1.10
7. 1.15
8. 1.30
9. 1.25

Cu SO4

10. 10.45 Feb.
11. 10.50 "
12. 10.55 "
13. 11 "
14. 11.05 "
15. 11.10 "

Cu SO4

19, 20, 21 = 2 x 2 in 200 c.c.
22, 23, 24 = " " " "

Feb. 6-
3. Am

19. 3. Am.
20. 3.05 "
21. 3.10 "

Cu SO4

22. 3.15-
23. 3.20
24. 3.25

Cu(NH4)2(SO4)2

68

1-511

0-51

Feb. 6

19. 57 Rm.
20. 9[illegible]05 "
21 5[illegible]11 "
} $CaSO_4$

22 5.15
23 5.20
24 5.25
} $Ca(NH_4)_2(SO_4)_2$

3.264
3.25-8.25-
.00573

2.984 | 20
2.97825-
.005 73

3.317 | 21
3.31025-
.006 73

5.75-
5.75-
6.75
3)18.25-
6.08

3.252 | 19
3.24225-
.009 73

3.25-45 | 20
3.24460
.0085

3.4045- | 21
3.395-
.0095

6.75-
8.15
3)27.75-
9.25-

6.08
9.25-
15.33

83.25-
84.25-
83.75-
81
4)332.25
36)83.106 (2.31
72
110
108
26

60)2.31.000+0385-
180
510
480
300
301

2.31

10 Bottles.

4 Pumps Calcopyrite.

1 – Sul acid, Equal quantity Coke to Calcopyr. place in warm place

2 = ditto place in ordinary temperature,

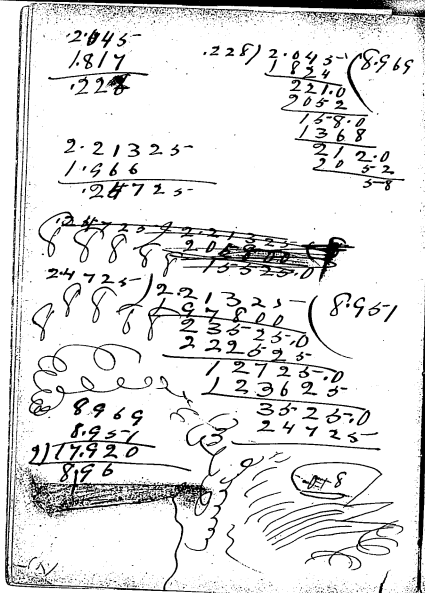
3 Sul acid – + Copper shavings = [illegible]

4 = Sul acid – [illegible]

5 Caustic Soda – [illegible]

6 – Bichromate [illegible]

7 [illegible]



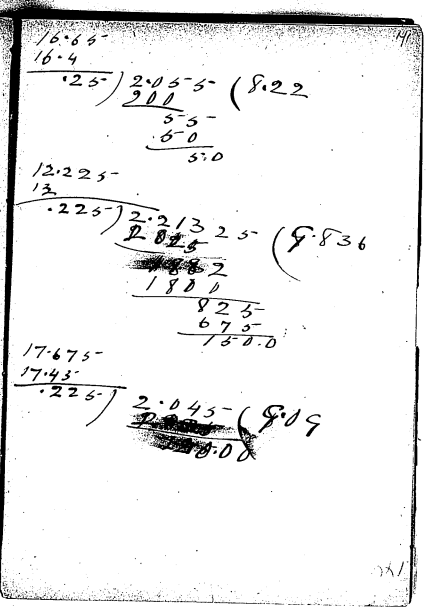
2·045
1·817
·228

·228) 2·045 (8·96
1824
2210
2052
1580
1368
2120
2052
68

2·21325
1·966
·24725

·24725) 2·21325 (8·96
19776
23570
22255
12725
12362
3630
2472
1158

8·969
8·96
17·920
8·96



16·66
16·4
·25

·25) 2·05 (8·22
200
50
60
50

13·225
13
·225) 2·2132 5 (9·836
2025
1800
825
675
1500

17·675
17·45
·225

·225) 2·045 (9·09
2025
20

Barberry
hornbeam
aspen wood
sycamore
poplar
Firwood.

Vegetable substance pressed between moist clay so that the vapour can escape slowly at a heat 200° & 300° [illegible] near the rewarking Coal = Firwood was also heated together in a close vessel to 400° yielded a coaly residue black, hard, lustrous shining, difficult to burn & giving off scarcely any trace of volatile matter when heated.

Charcoal not free from
O, X + H. Even if heated to
the melting point of platinum

Superheated steam renders
charring more uniform +
causes it to take place at
lower temperature,

Charcoal prepared by Superheated steam at 430 has properties
Charcoal prepared without steam at 1200°

Wood when treated with
aqueous alkalis becomes
less rich in carbon because
incrusting matter is removed
& cellulose remains in a
state of greater or less purity
(paper)

108 : 170 :: 480 : x

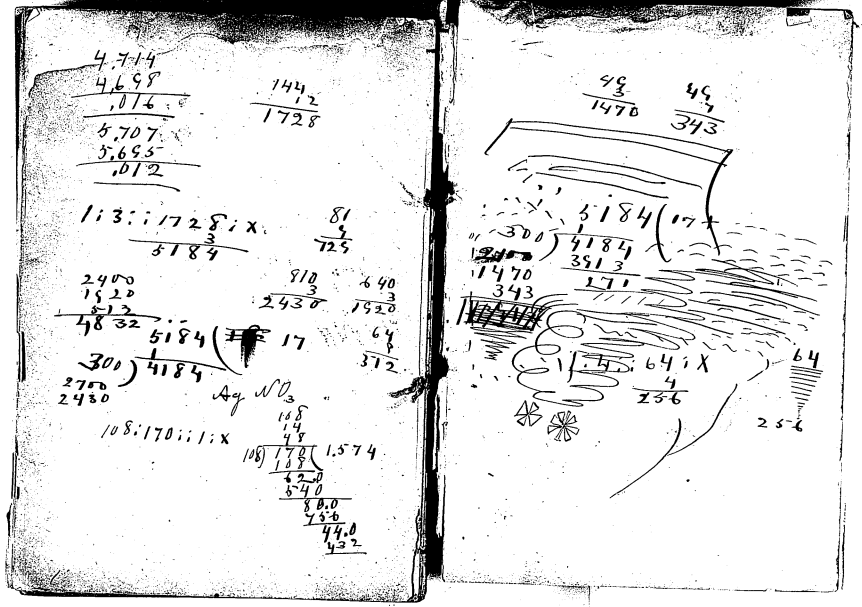
170
33600
480

108) 8160.00 (75.5.5.5

756
600
540
600
540
600

437.5) 75.5.5.5 (1.72

437 5
3180 5
3062 5
1180.0
875
3050.0

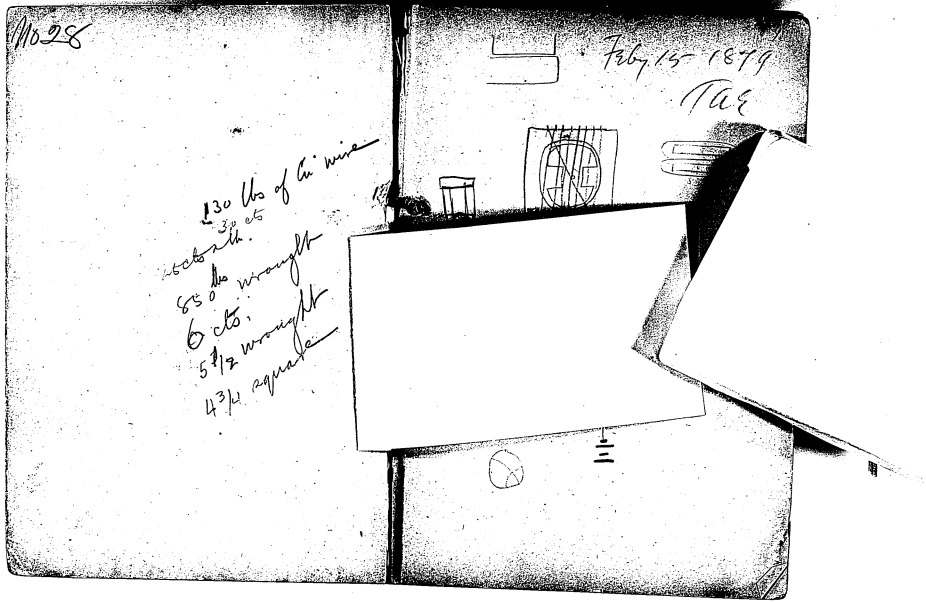


Menlo Park Notebook #28 [N-79-02-15.1]

This notebook covers the period February-November 1879. Most of the entries are by Edison and Francis Upton. There are also entries by Charles Batchelor and Francis Jehl. All of the entries relate to electric light and power experiments, except for one drawing by Batchelor of a telephone circuit. The electric light material includes notes, calculations, and tests of lamps; notes, drawings, and calculations relating to generators; and notes and calculations about electric power distribution. The book contains 278 numbered pages.

Blank pages not filmed: 234-277.

Missing page numbers: 51-52, 89-90, 107-108, 279-280.


No 28
Feby 15 1879
TAE
130 lbs of Cu wire
39 cts
65 lbs wrought
6 cts.
5 1/2 wrought
4 3/4 square

No 28

Feb. 15 1879

Tax

130 lbs of fine wire

30 cts

LIBRARY OF THE

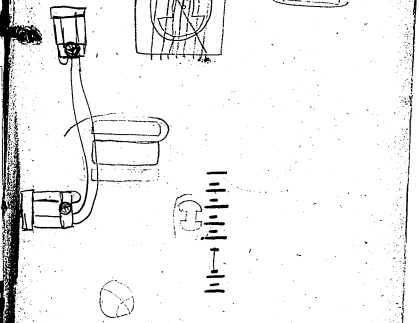
BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

[illegible]

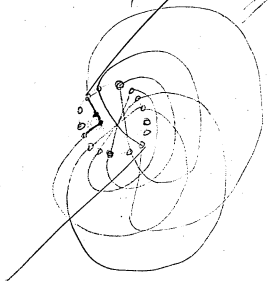
[illegible] N.Y.C.

[illegible], 189[illegible].

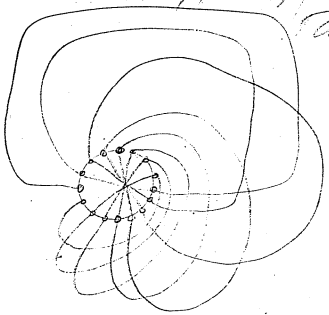


Feby 15 1879
Tue

Feby 14 1879

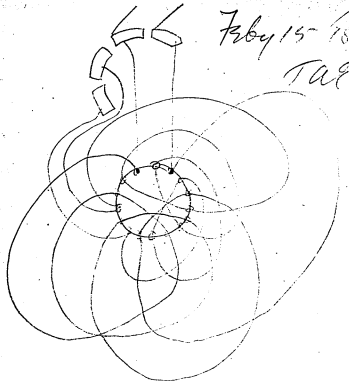


Feby 15 1870



Feby 15 1879

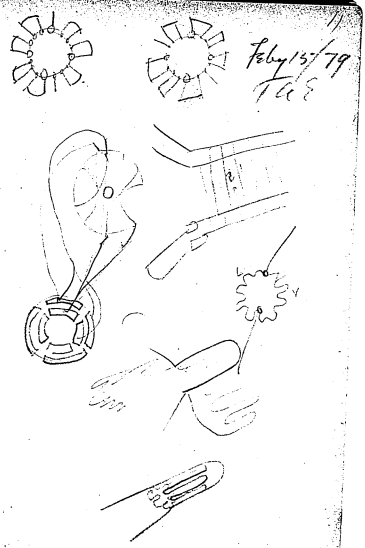
TAE



10

11

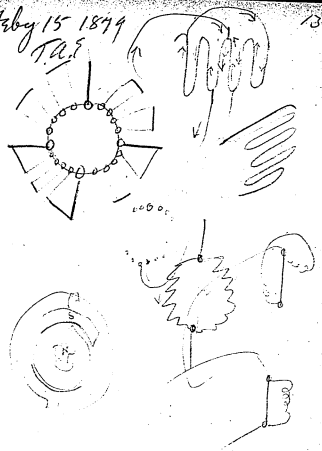
Feby 15-79
Tue



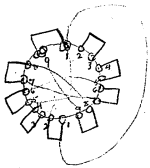
12

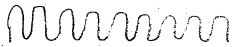
Feby 15 1879
T.A.E.

13



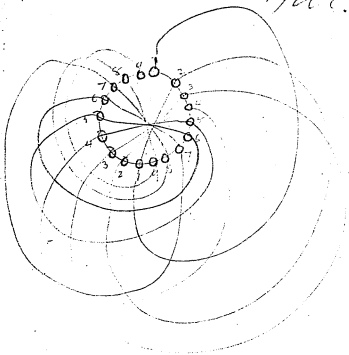
Friday 15 1849





Feby 15-1879

Tait.

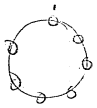


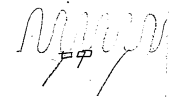
18

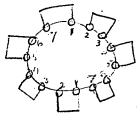
May 15-1879 19

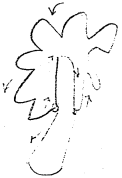
5

45

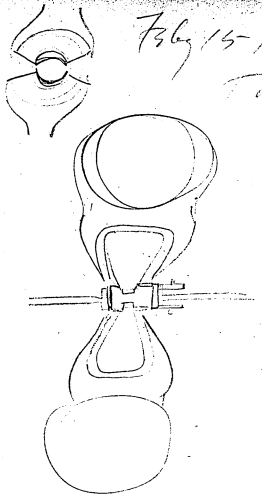


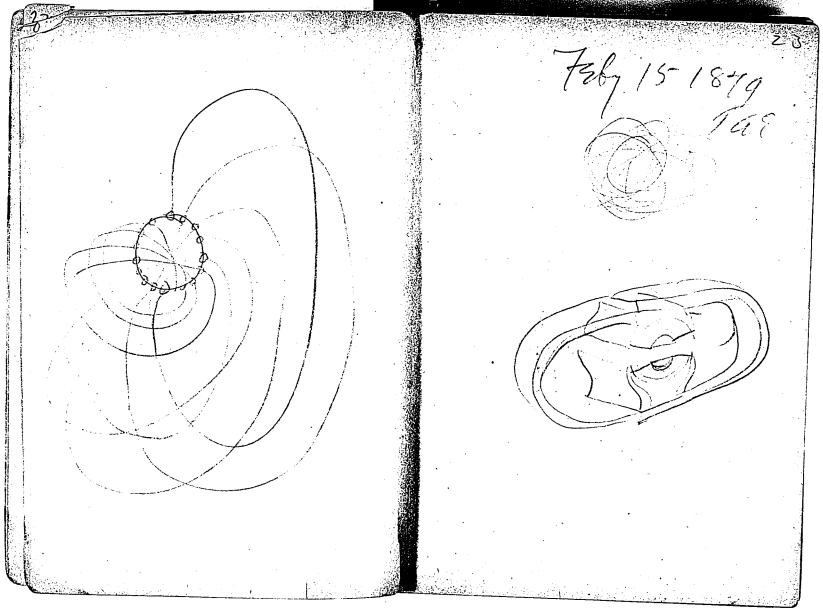






Feby 15 1819

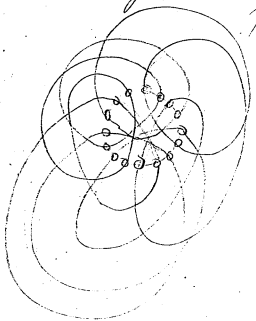



Feby 15 1879
Tat

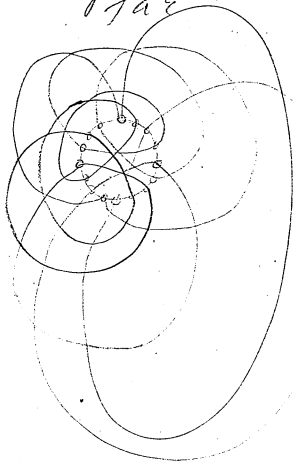
24

Feby 15 1879

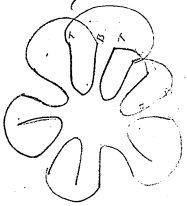
TaE

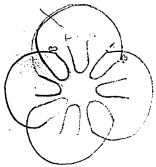


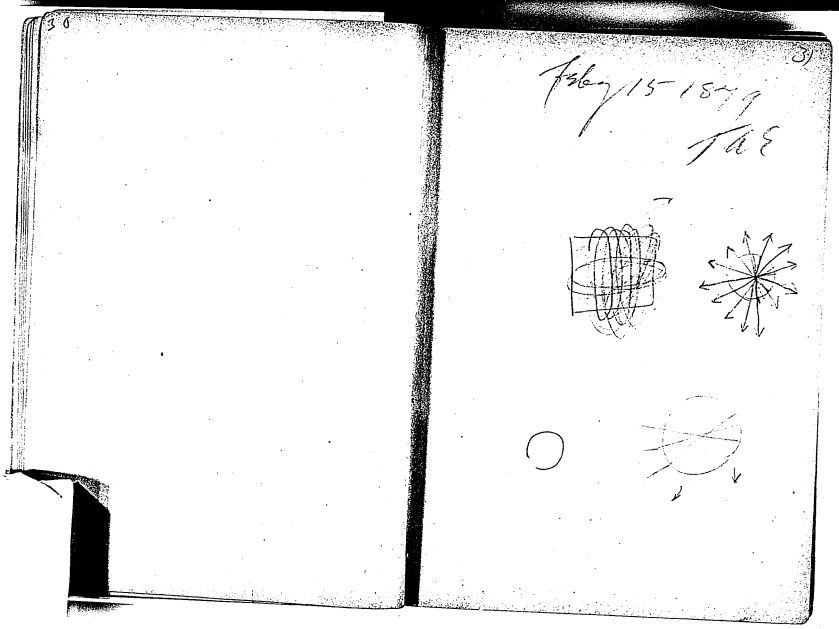
Febry 15 1879
T a E



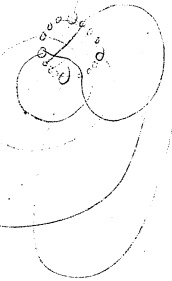
Feby 15-1879

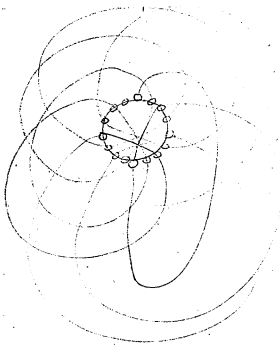





Feb 15 1849
TAE

Feby 15 1879
Tas

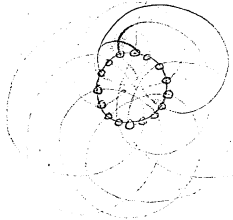




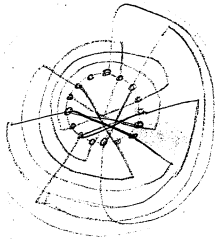
Feby 15-1870

TCS

Feby 15 1874



Feby 15-1849



Feby 15-1879

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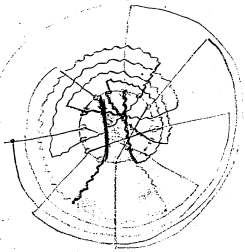
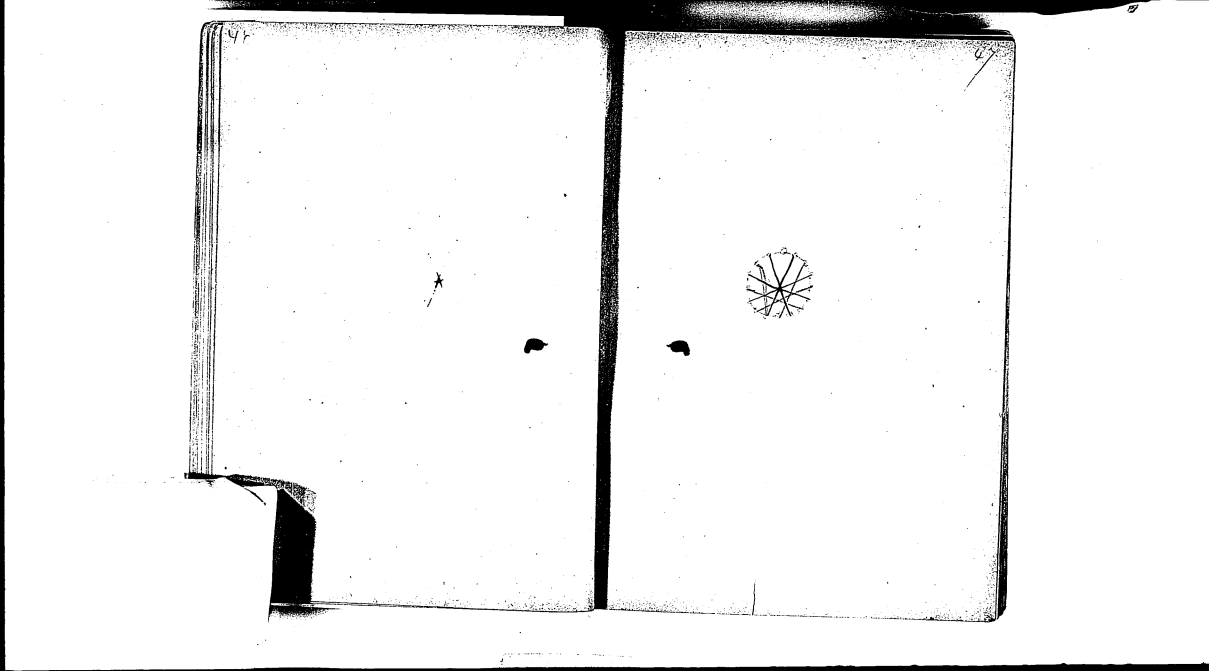


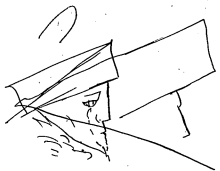
Dynamo Machine

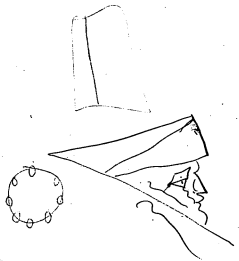
T. A. E.

Feb. 16 1879



Feby 16 1879





Feby 16 1879

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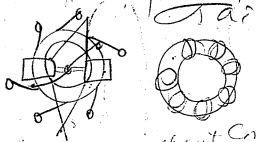
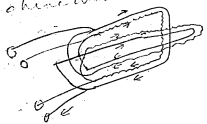
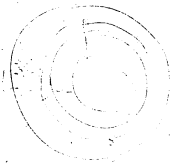
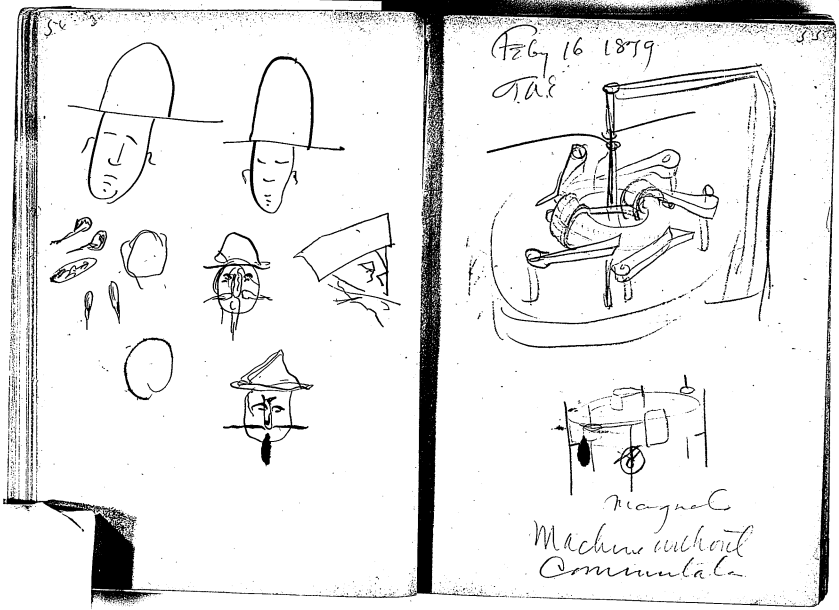


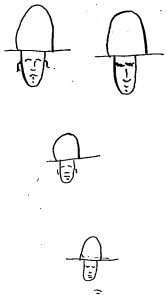
Machine circulant Commutateur






Feby 16 1879
G.A.E
magnet
Machine without
Commutator

56



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Feb 16. 79
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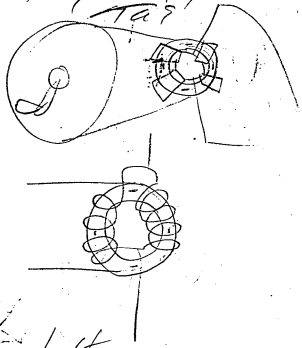

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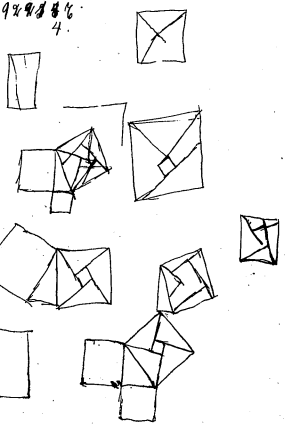
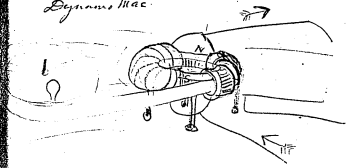


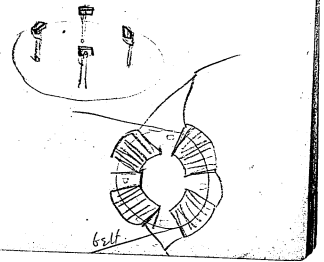
Feby 16 1879

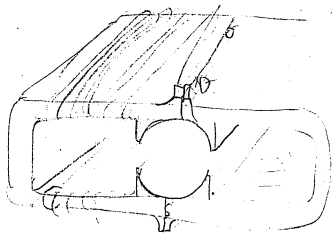
59

non-commutative

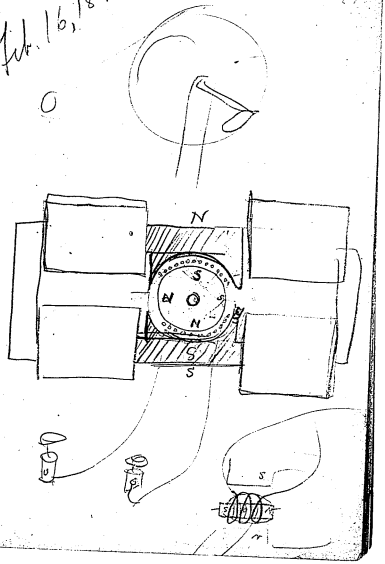
Dynamo Mac







feb. 16, 1878



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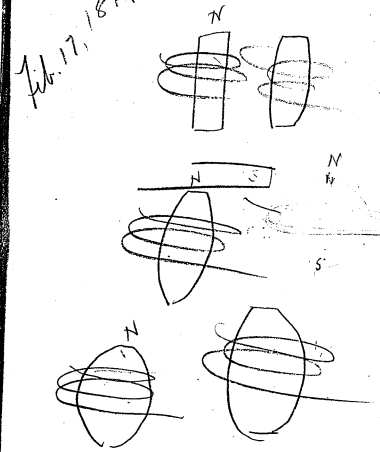

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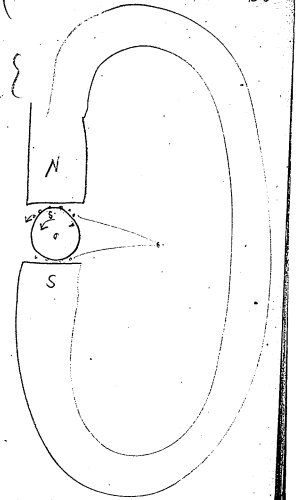
Wt. 11th 1899.



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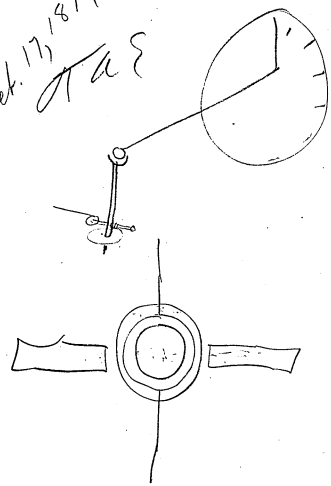

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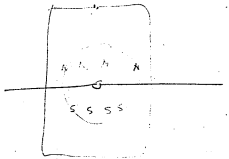
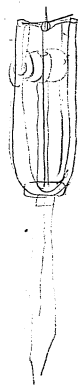
69

Feb. 11, 1879

No. 211,845





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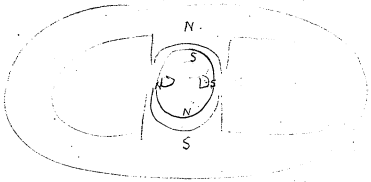

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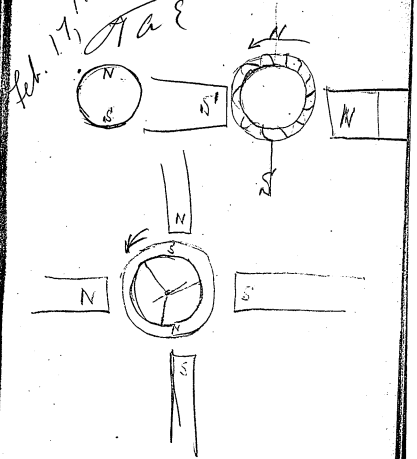
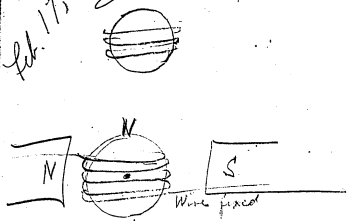
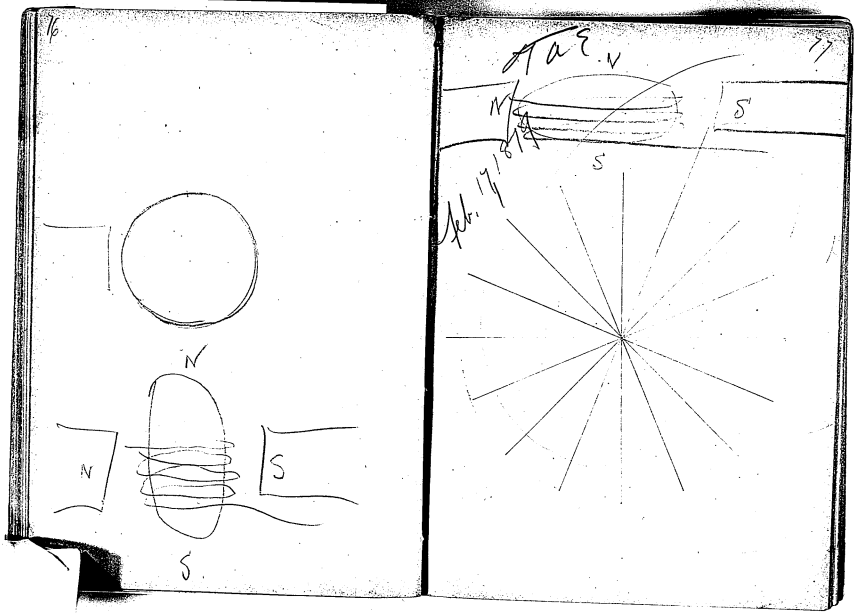


Feb. 11, 1899

Iron core



The turns will be on the wire and not on the iron core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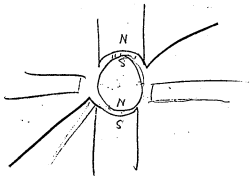

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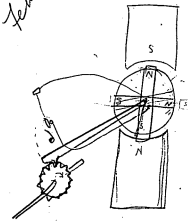

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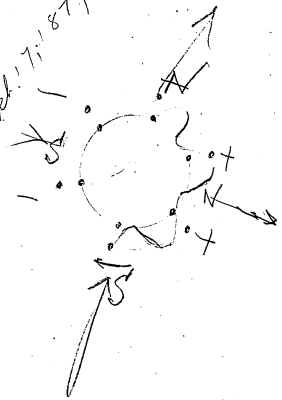

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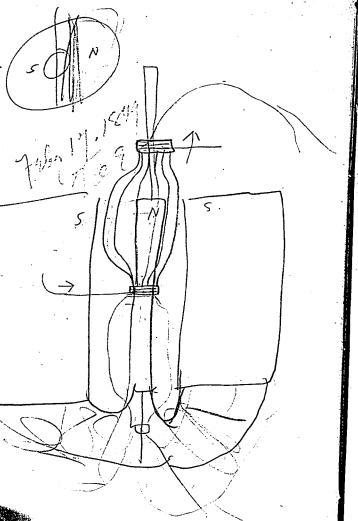
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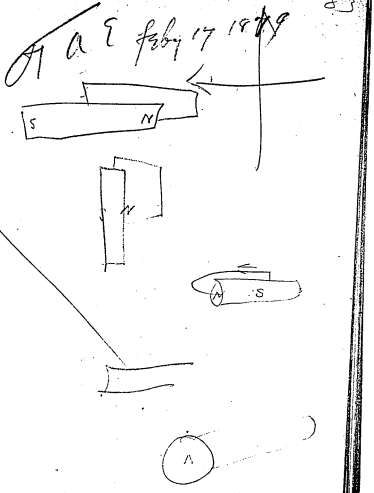
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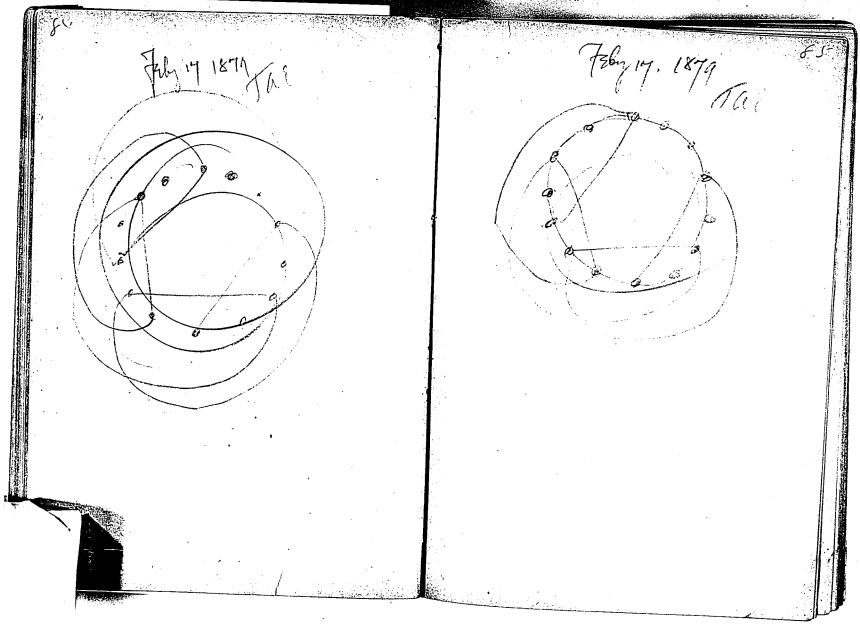
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86

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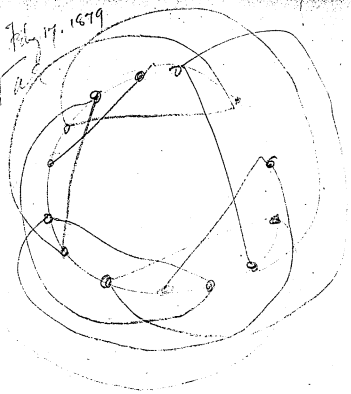

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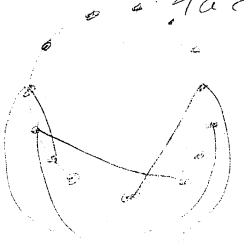

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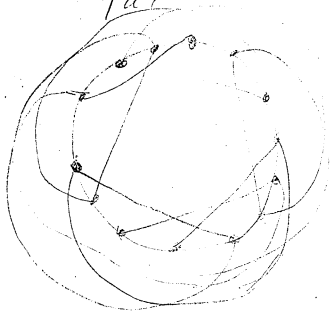
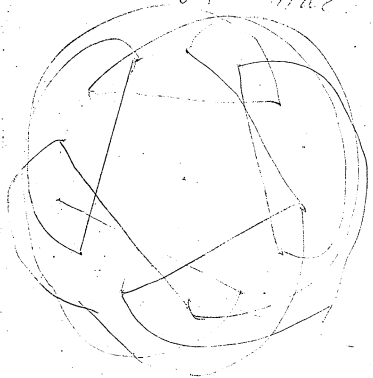


92

Feby 17, 1879

93



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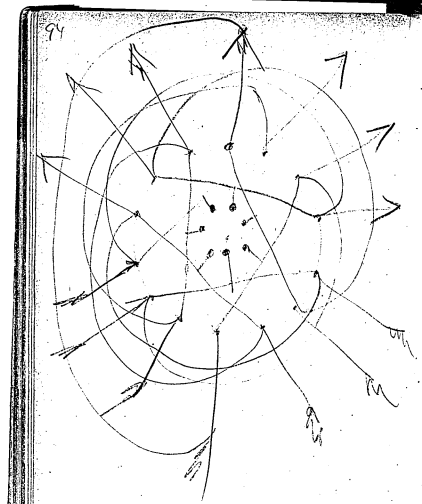

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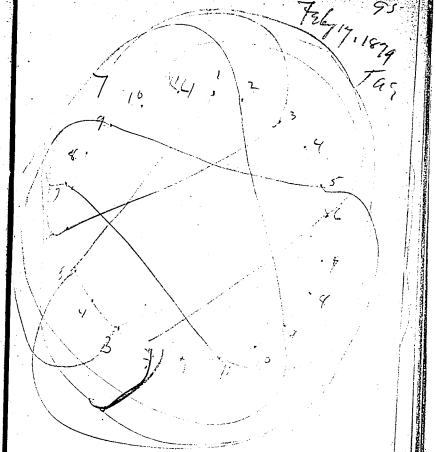
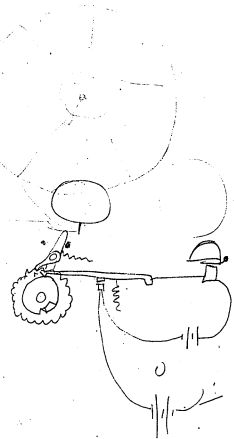
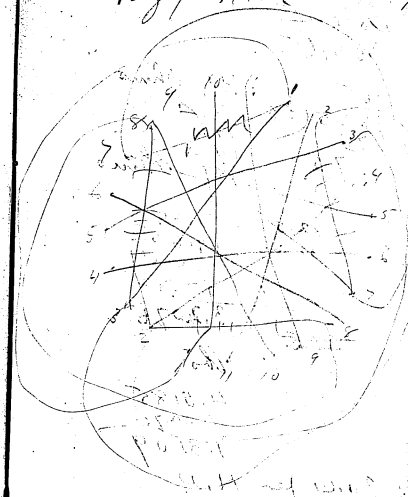






3 in
15 Volts

165
15 | 82.5 | 5.5
75
75

34 ohms
5.5
170
170
187 ohms

82.5	1.9165
82.5	1.9165
44.3	1.6464
Comp 187	7.7282
	3.2076

~~2555~~

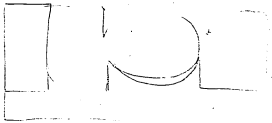
1610 ft. lbs

	4.5185
	3.2076
	1.3109

2014 per N.D

$$44\overline{)33.000}\,(750$$
$$308$$
$$220$$

Feby 17 1879 Tue



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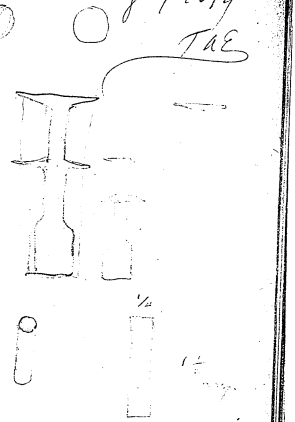
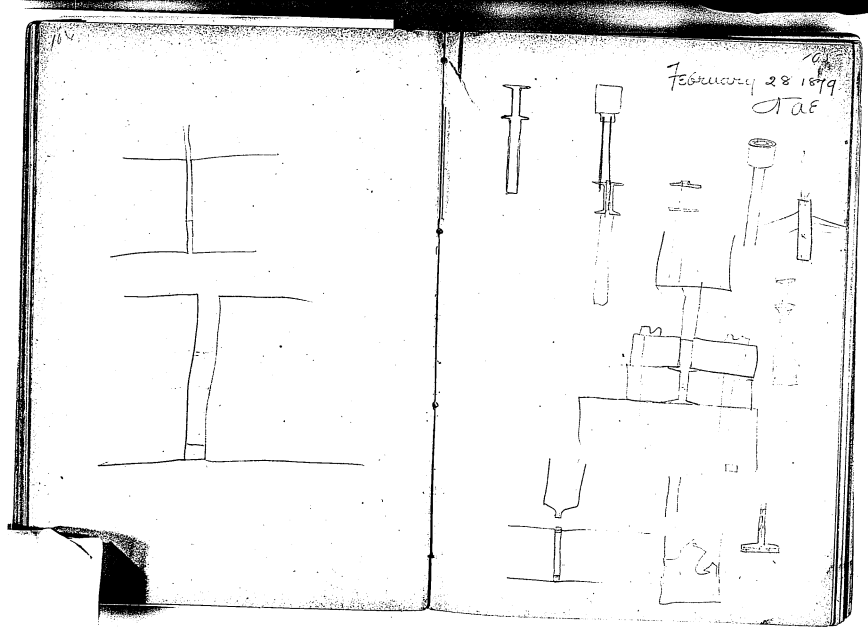
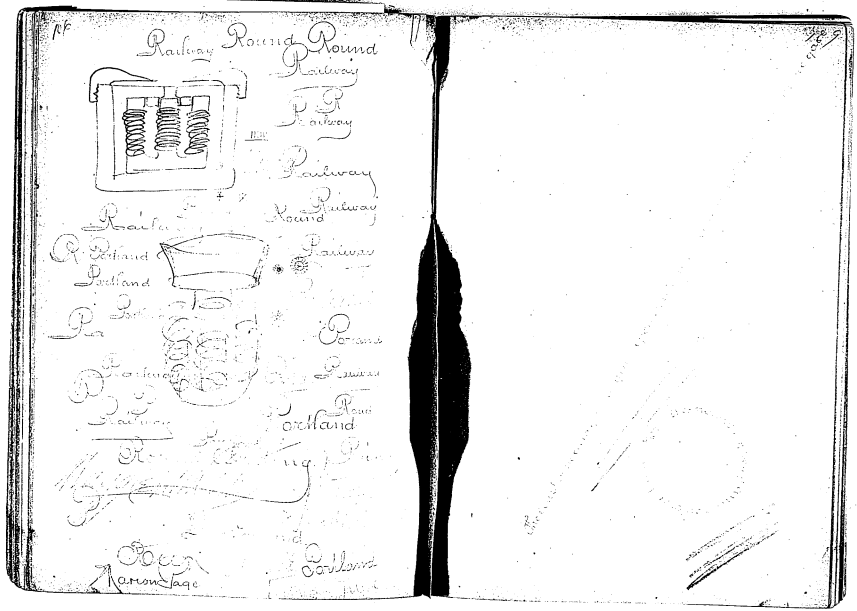



February 28 1879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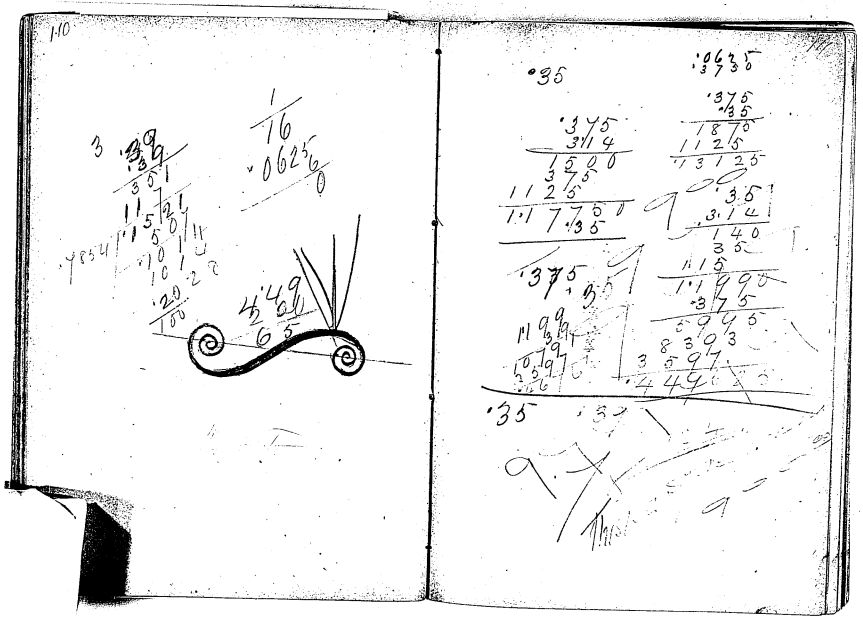
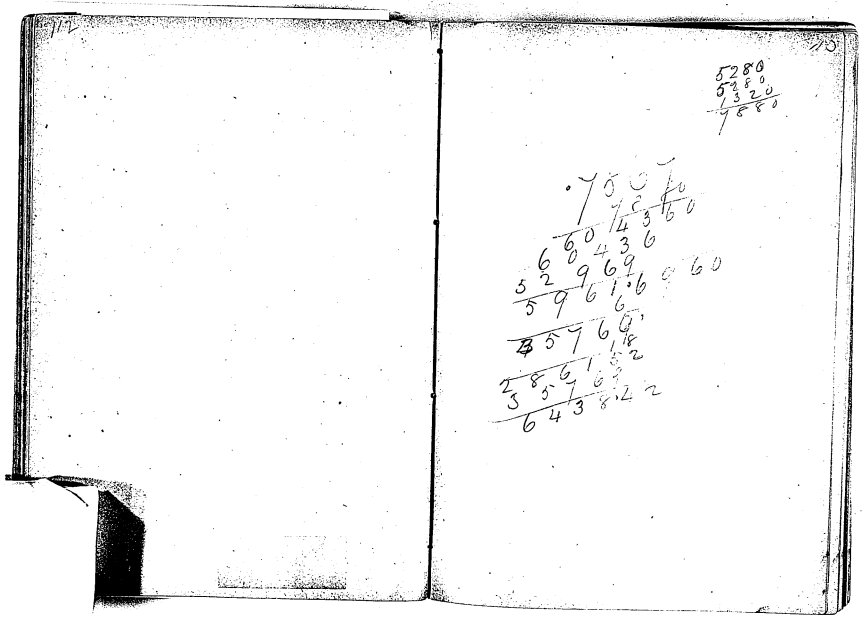
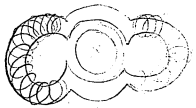




No 1

X Cylinder stands 0.C.C
with Thorn through lines
force



Over

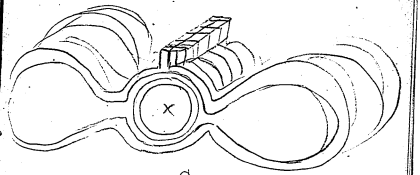
[illegible] there [illegible] see
account [illegible] by [illegible]
field [illegible]
[illegible] of two [illegible] & 3rd rotate

Experiments to be tried.

Rotating wire wound in odd no -
" " " in Even with end opp.

Open fuse weight put iron in sealed
put in Siemens annular bobbin
wire stitch rotating annular
wound magnet over wire bobbin
against iron -
hold both magnets (Siemens annular
& over stitch rotating wire wound)
both Even & odd -

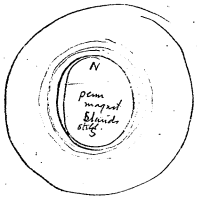
No 2



Permanent magnets.

X Cylinder of soft iron
with wires

N 03



Wm. Crookes

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16. 7' 60.

20

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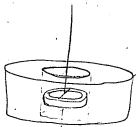
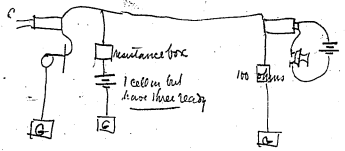
25.

900.

10,




C
Resistance box
1 cell in test
leave three ready
100 ohms
G
C
G

126

36 Ohms 1/6 amount

No. 16 wire 259 ft per ohm

	2.4131
36	1.5563
9320 ft	3.9694
	.7782
1/6 amount	3.1912
1550	

No. 10 wire

1090 feet per ohm

Strength = 1090 94 lbs

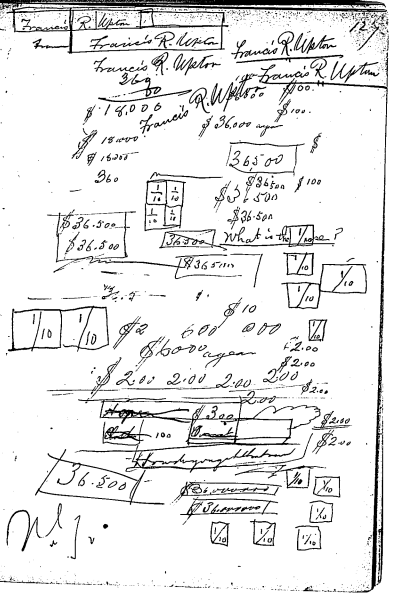
Strength = 1550

No 16 wire 5.23 .7183

36 1.5563

2.2746

187 lbs of wire 1.5 more effective on six Ohms total



80 H.P. engine [20] machines
running 4 H.P. each
Two machines being driving the
fields of the others

9 machines to each
9 machines to each

What is the best resistance
for the magnets, and how
wind them

I want to know the
strength of current from
magnets. current from
current from
from

Required the strength of the
magnetizing current and
the strength of the current
from the machine.
The magnetizing current
could be measured by the
Dynamometer
[illegible] by the Elec-
trometer. Electrometer

Electrometer

2 lamps in series
1 unit of surface each
1 unit of energy from each
1. lamp

a lamps in series
unit of surface each
.. .. energy given off ..

1 lamp in multiple utilizing the same E.M.F. as a lamps in series what will be the resistance of a lamp?

$\frac{1}{a}$ energy given off on unit of surface

$\frac{\mathcal{E}^2}{R_x} = \frac{1}{a}$ $\quad \mathcal{E} = 1$

$\frac{1}{R_x} = \frac{1}{a}$ $\quad C = \frac{\mathcal{E}}{R}$

$C^2 R = W$

$\frac{\mathcal{E}^2}{R} = W$

$\frac{1}{R} = a$

$\frac{1}{R_x} = \frac{1}{a}$

$\frac{a^2}{R_x} = \frac{1}{R}$

$R_x = a^2 R$

132

$\mathcal{E}_2 = \mathcal{E}_1 \frac{r_2}{r_1}$ $\mathcal{E}_2 r_1 = \mathcal{E}_1 r_2$

$\mathcal{E}_2 = \mathcal{E}_1 \frac{r_2 + b}{r_1 + a}$

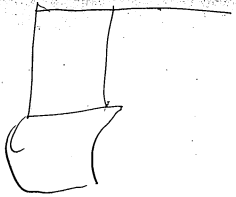
$\mathcal{E}_2 a = \mathcal{E}_1 b$

$\mathcal{E}_2 = \mathcal{E}_1 \frac{b}{a}$

6.85
40
274.00
27.40
13.70

6666

133



$\mathcal{E} = 20$ 16. ohm

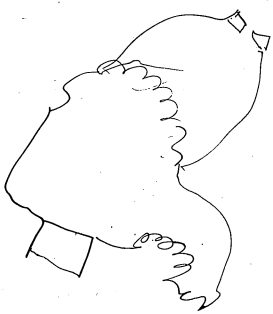
$\frac{400}{16} = 25 =$ Work

$C = \frac{E}{R}$ $\frac{100}{16} = \frac{25}{4} = 6\frac{1}{4}$

C R

$\frac{20}{16} = \frac{5}{4} =$ Current

$\frac{25}{16} \times 16 = 25 =$ Work



485000 and

485.000 000

485 000 000

2

83 cts. cts. cts cts. cts.

83 cts. cts. cts. cts. cts

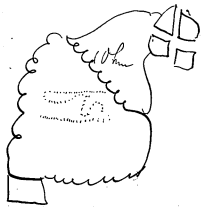
83 cts 83 cts cts

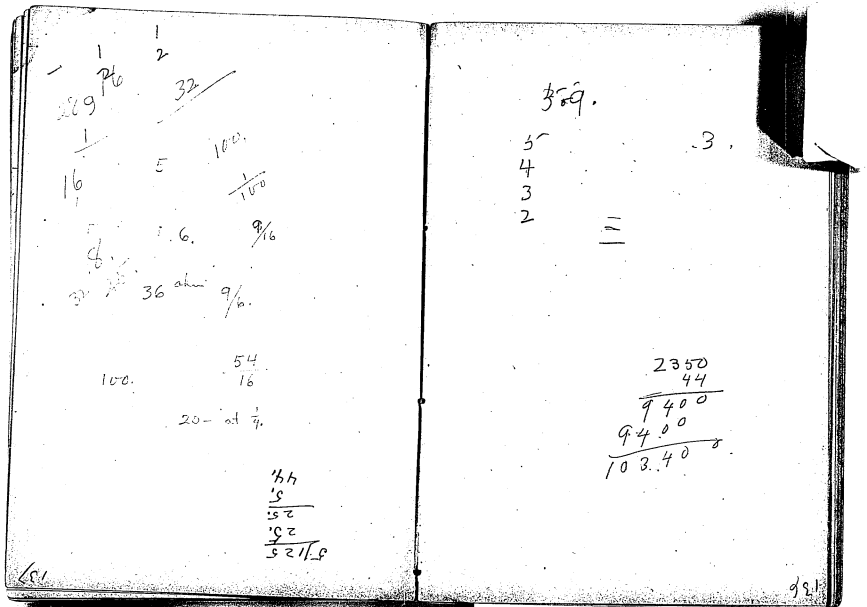
83 cts. 83 cts. 83 cts.

83 cts. 83 cts 83 cts

83 cts

83





1
2

289 pb 32

1/16

5 100.

1/100

1.6. 9/16

36 ohm 9/16.

100. 54/16

20- at 1/4.

5,121 / 2 5 / 2 5 / 5 / 4 4

359.

5
4
3
2 =

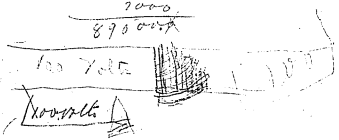
.3.

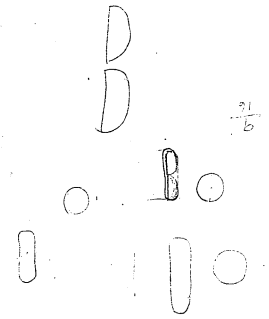
2350
44
9400
9400
1034.0

100 Volts on 4 Ohms

20
2000

44.5
2000
89000





I want to know the E. M. F required — from a 100 ohm lamp with 4, 5, 6, 7, 8, 9, 10, 11, are Stamped for H.P.

44.5

$44.5 \frac{E^2}{R} = \frac{H.P}{4}$

$R = 100$

$E^2 = 100 \frac{H.P}{4 \times 44.5}$

$E = \sqrt{100 \frac{H.P}{4 \times 44.5}}$

100
33000
4.45
178
178.0
178

Comp 178.

2.
4.5185
7.7496
4.2681
2.1340

6.5185

136 Volts 4 per H.P

$\sqrt{\quad} = \frac{H.P}{8.V44.5}$ $\frac{44.5}{5}$ 222.5

6.5185
2.3474
4.1711
2.0855

222.5

121 Volts

144

6 per H.P

44.5

6.5185
1.6484
4.8701
6 .7782
4.0919
2.0454

111 Volts

7 per H.P

4.8701
.8451
4.0250
2.0125

103 Volts

8 per H.P.

4.8707
.9131
3.9670
1.9835

96.3 Volts

145

9 per H.P

4.8701
.9542
3.9159
1.9579

90.8 Volt

10 per H.P

4.8701
2 3.8701
1.9350

86.1 Volts

11 per H.P

4.8701
1.0414
3.8287
1.9143

83 Volts

146

75 1.8751
75 1.8751
comp 1.00 4. -10
44.5 1.6484
1580 3.1986
4.5185
3 1986
1.3199
208 per H.P.

1 per H.P
4.8701
2.4350
266 Amps

147

2 per H.P.
4.8701
.3010
4.5691
22845
192 Volts

3 per H.P 4.8701
.4771
4.3930
2.1965
157 Volts

4 per H.P .4.8701
.6021
4.2680
2.1340
136

Exm. F required to run a 100 Ohm Lamps.

If there are obtained for each horse power this number of lamps
1

4.8701
1.0792
~~3.7309~~
~~1.8654~~
3.7909
1.8954

4.8701
1.1139
3.7562
1.8781

4.8701
1.1461
3.7240
1.8620

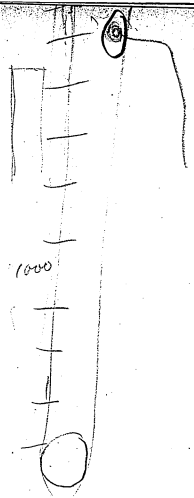
4.8701
1.1761
3.6940
1.8470

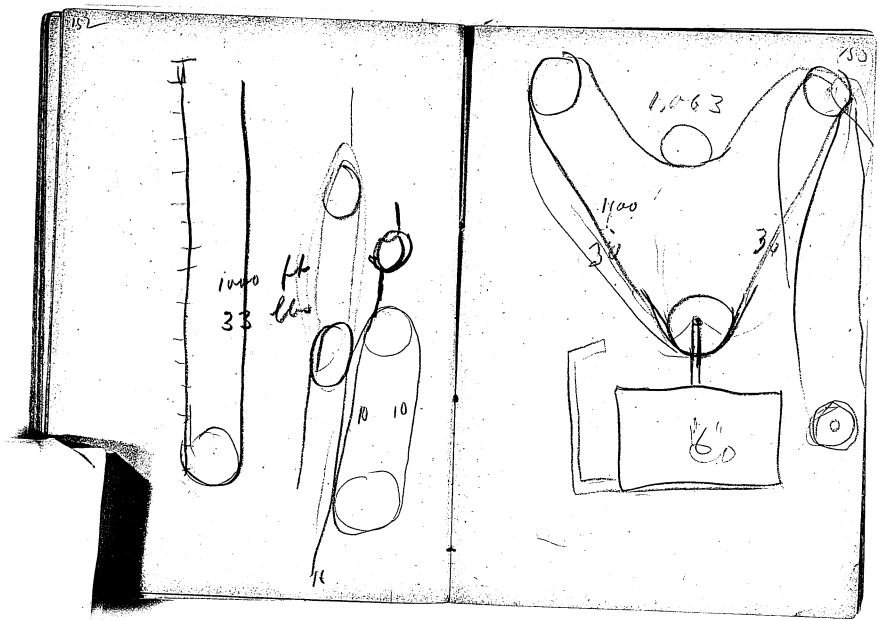
150

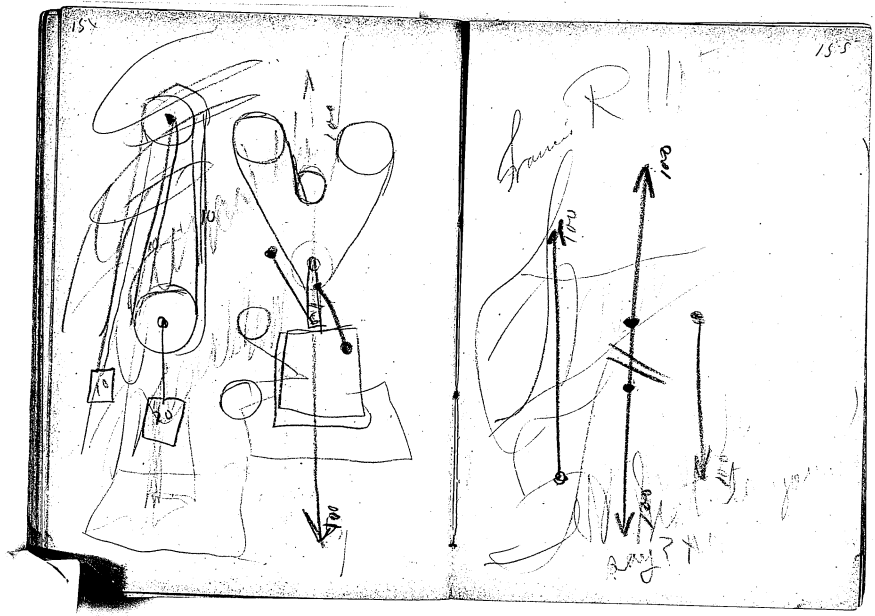
Work Energy

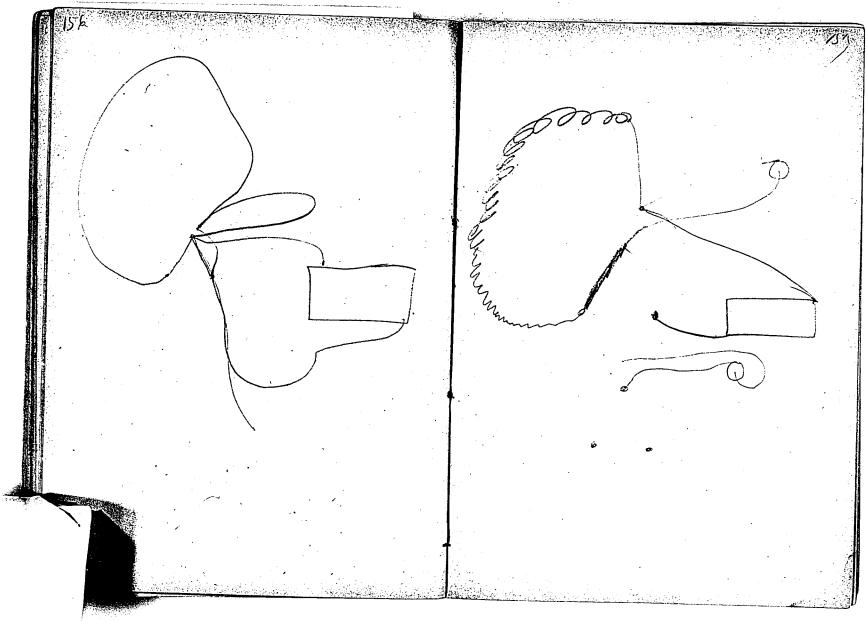
Energy Work

151




1000 ft
33 lbs
10
10
1,063
1100
36
36
60





to drain

60

61

Experiments on Standard 163

Dynamo Machine. July 7 1879

T. A. Edison

10 Experiments to determine loosing of weight with no belt on Dynamo

(1st) starting in fictitious weights

Speed Chart 185

Last speed taken - count revolutions

938½ @ 9½ = 938½ - 920

944½ - 916 = Mean of whole.

946 = 910

943 = 912

943 = 913

940½ 911

940 915

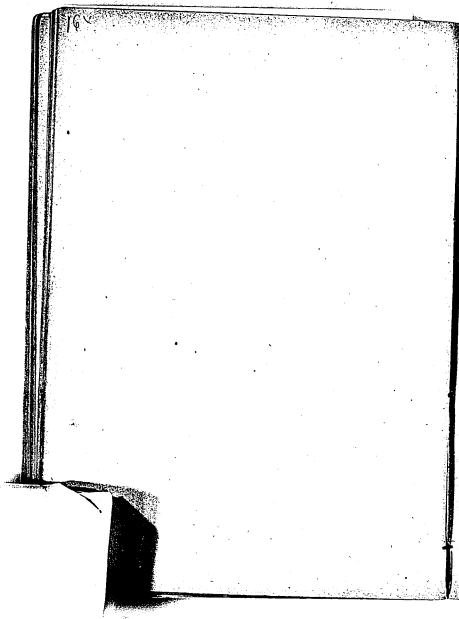
943 913

938½ 918

927.37

Initial weight

960

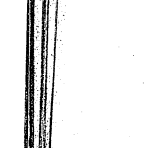


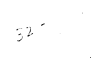
we now take 10 weighings with belt on Dynamo circuits open speed of Dynamo. 1st time 524.- 2nd time, 524 —

936 ½	– 907	mean deflection of
935	909	balance
935	910	921.2
934	906 ½	
935 —	906 ½	Lessening of
934 ½	908	weight
934	905	6.17
934	908	
934	908	Calling speed of
935	908	shaft 124, &
		speed of belt is
		1143 feet.

The world gave 3757. foot lbs
absorbed by machine, or $8\frac{9}{10}$,
machines per h power —
We now put Gathem on field
magnet, Resistance of field
was $\frac{90}{100}$ of ohm. Velocity reading
$8\frac{2}{10}$ rebers. Left Tam gal $60\frac{1}{2}$
speed shaft 154 — Power 11.58
& Dynamo 534 —

903 —	$934\frac{1}{2}$	Mean adopted
$904\frac{1}{2}$	933	
903	$930\frac{1}{2}$	915+85
903	$926\frac{1}{2}$	
902	$925\frac{1}{2}$	Sick 11.52
933	$925\frac{1}{2}$	
933	928 or 7010	
902	927	Screwing [illegible]
908	$925\frac{1}{2}$	Field [illegible]
901	925	wj 3253.





We now take Current Cross

The Machine –

Speed Main shaft 186.
47th deg on Tangent 5th

1		
815	843 1/2	
820	845 1/2	
820	845	
819	843	
818	847 1/2	
818	847 1/2	
823 1/2	847	
822	846	
821 1/2	846	
823	847	

Another test using more power, by having both on smaller external resistance;

Gal 44 1/2

85 1/2	820
848	820

Balling pumping out.

We make R smaller and vary test again =

834 1/2	+ 804	= 2)1641.5	820.75
835	+ 808	= 2)1643	821.5
832	+ 808	= 2)1640 1/2	820.25
838	+ 806	= 2)1644	822
838	+ 808	= 2)1646	823

5741 09.5

821.9

Smooth. Ha ; on 2 lathes
Each 10 hours a day a lathe
a H.P.

30000 a day

33 | 506 | 1.51
33
170
165
50
1.51 H.P. a day

1.51 Cts a day

365
1.51
365
1825
365
5.5 1.15

$5.51

Cost $23 to put on twice as many layers

1/2 Diameter

1/4 times the convolutions

1/6 times the resistance

The same E.M.F

1/16 the current

1/4 as strong

1/4 the current

the same strength

1/16 X 16 = 1 Cost

180 lbs of Copper

$37.00
42.50
$81.50

85.50
$42.50

$8.15

10 6 3 6.50 10 $36.50

$6.08

2 cts. per H.P.

20 cts an hour

H.P

2½ 2.5 lights

lights lights lights

Cost H.P.

178

Unit lamps per hour
10 per H.P.

3 hours each day

2 cts cost power
.2 cts per lamp per hour

$100 per H.P. engines boilers
$10 per lamp per H.P.
$3.33 dynamo
$7.50 Conductors

36 $20.83
2.83
1000 hours a year
.28 interest
.20
.48 per hour
7.00 per M

Switch
7.00 per M

179

Land
$200 for dynamo Machine
80 lamps
333

Two cells Two cells
Two cells Two cells
Two cells Two cells
Two cells Two cells
Two cells Two cells

150 Ohm lamps
1/4 per H.P. theoretical to make the lamps a economy Edison success. The lamps must be permanent and last years. Ohm 5 B. gas.

180

Nov 7 1879 A.1

For testing carbon lamp.

Size coiled thread .02

Resistance of lamp when cold = 86.-1 = 85.9 Lamp when used

I made 5 at Daniell & 6 chromic cells = 35. about 17 volts per volt = 2

53 : 78 :: 365 : X

Cherry Red

= R. 53.86

ft lbs 1251.

Bright Red

R=50.61

ft lbs 2467 lbs

181

Bright white

37.1 X :: 82 : 110

R 49.76

3.480726
1.646404

5.127130
1.696953

3.430177 ft lbs

2702. ft lbs

Brilliant white

30.7 X :: 78 : 121

R. 47.62

3,348. ft lbs

3.524878 = ft lbs

~~Ro~~ 80 ohms when measured cold now —

1 litre of air weighs

1.293 Grammes

.45359 Kilo

453.59 Grammes

453.5 2.65658

1.293 0.11160

2.54498

3500 litres 1

1.135 2.54498

.03520

2.59998

6398 Quarts

995 Gallons in a pound of air about

140

100

44.3

25) 443,000 (177.000

25

193

180

13

33) 177 (5.4

165

120 .27

33,000

8250

5500

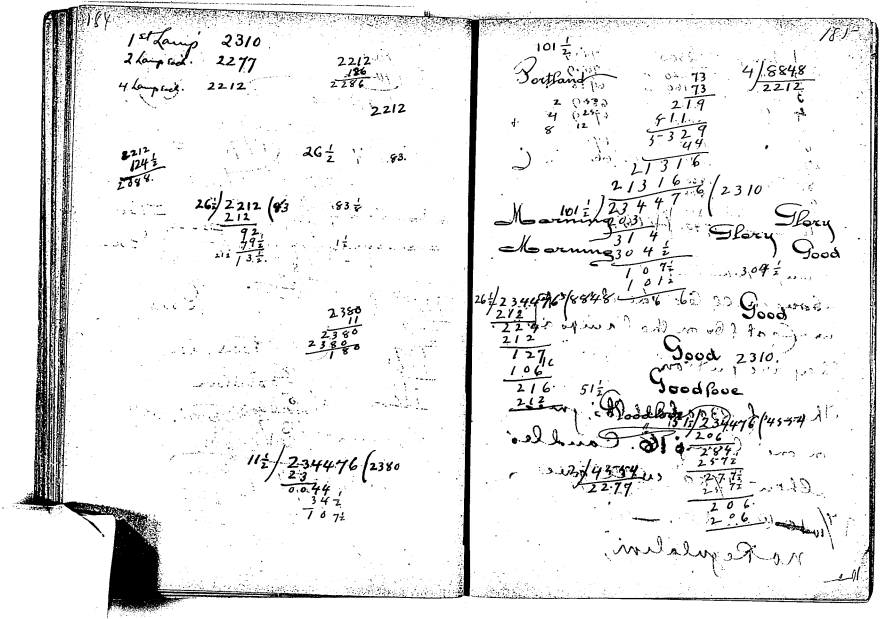
1750

1650

100

90

10



1	lamp	2300	71.9
2	"	2220	70.9
3	"	2160	69.8
4	"	2100	68.9
5	"	2040	67.9
6	"	1960	67.
7	"	1920	66.
8	"	1860	
9		1800	
10		1780.	

10 lamp. 1 ohm Carb 1/4 ohm machine above table the distribution of Foot lbs on the lamps are they are put on.

The [illegible] Foot lbs. given on one lamp 16. Candles then 1780 [illegible] 9 7/10 Candles

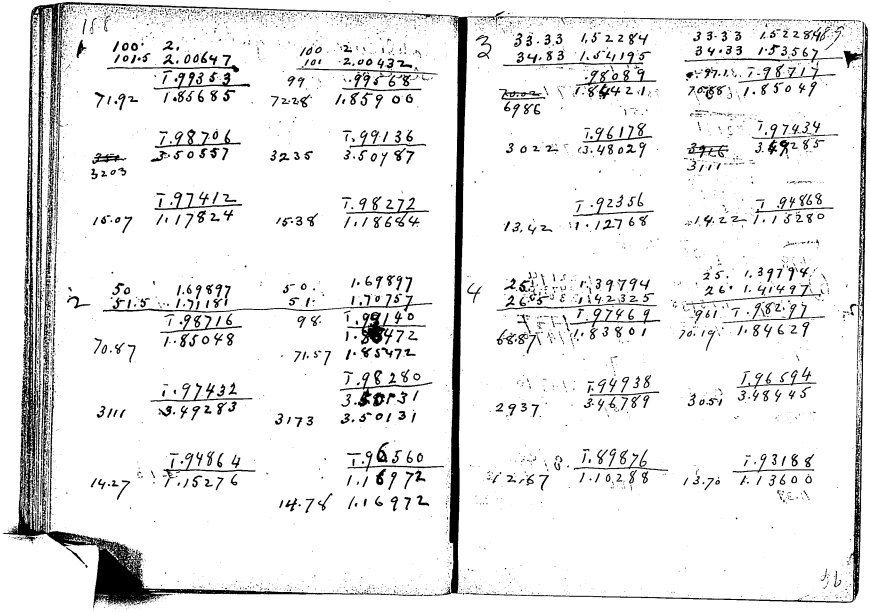
no Regulation.

Table with regulation at 1 lamp

1	lamp	2305	72.4
2	"	2268	71.1
3	"	2220	70.8
4	"	2182	70.2
5	"	2141	69.5
6	"	2100	68.8
7	"	2023	67.6
8			
9		1951	66.8.
10			

Keeping record Enot at machine Carbon table above table gives distribution of Foot lbs 2305 - ft lbs given 16 Candles 1951 foot lbs will give 11 9/10 Candles

Regulation



5) 20 1.30103 / 21 1.32222

1.96889 — 1.97871

1.83191 — 69.51 1.842203

6791. — 1.95742

29.92 3.47593

2856 — T.93718 / 3.45569

T.91484

13.15 1.11896

11.98 — T.87436 / 1.07848

6) 16.67 1.22194 — 16.69 1.22194

18.17 1.25935 — 17.67 1.24722

66.98 — T.96259 / 1.82591 — 94.3 T.97476 — 68.87 1.83802

T.92518 / 3.44369 — 27.78

T.94940 / 3.46791 — 29.37

T.85636 / 1.05448 — 11.33

T.89880 / 1.10292 — 12.67

7) 14.28 1.15473 — 14.28 1.15473

15.28 1.19811 — 15.28 1.18412

68.06 — T.95662 / 1.84994 — 98.4 T.97061 / 1.83393

2702. — T.91324 / 3.43175

2882. — T.94122 / 3.45973

1070 — T.82648 / 1.03066

12.21 — T.88244 / 1.08656

8) 12.5 1.09691 — 12.5 1.09691

14 1.14613 — 13.3 1.13033

65.18 — T.98078 / 1.81410 — 92.6 T.96658 / 1.82990 — 67.60

T.88156 / 3.40007 / T.90156 / 8.42007 — 2631.

T.93316 / 3.45167 — 28.29

T.76312 / 0.47724 / T.80312 / 1.00724 — 10.17

T.86632 / 1.07044 — 11.77

9

11.111	1.045757	11.111	1.045757
12.611	1.100075	12.111	1.083317
6.33	1.945000	9.17	T.962589
	1.880832	66.97	1.825790
	T.89006		T.92516
2562	3.40851	2778	3.44367
	T.78000		T.85032
.9641	0.98412	11.83	1.05444

10

10.		10.	1.041397
11.5	1.060790	11.	
	T.93930	909	T.95869
63.48	1.80262		1.82201
	T.87860		T.91738
2495	3.39711		3.43589
	T.75720		T.83476
9.148	0.96132		1.03888

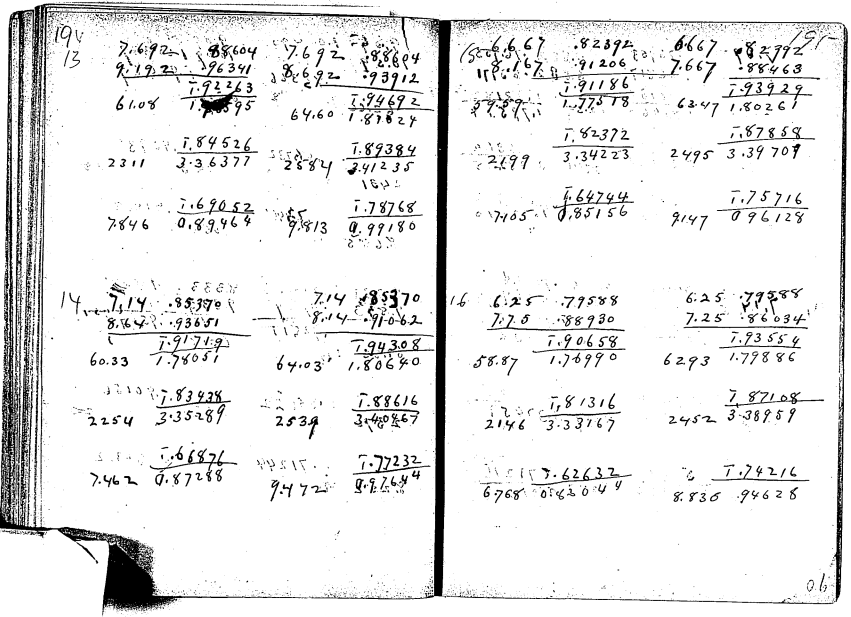
10-94

11

9.09	1.042490	9.09	1.042490
10.09	1.003887	10.09	1.003887
5.166	T.72366	65.77	T.95467
	1.77678		1.81799
	T.86732		T.90934
2431	3.38583	2678	3.42785
	T.73464		T.81868
8.685	0.93876	10.54	1.02280

12

7.833	.92080	8.333	.92080
7.833	.99269	9.333	.97003
67.86	T.92811	65.18	T.95078
	1.79143		1.81410
	T.85622		T.90156
2370	3.37973	2631	3.42007
	T.71244		T.80312
8.252	0.91656	10.17	1.00724



196

17) 5.882 .76963 → 5.882 .76963
7.382 .86817 → 6.882 .85771
7.90136 → 7.92182
58.17 1.76668 62.39 1.78514

7.80272 → 7.86364
2095 3.32123 2411 3.88215

7.60544 → 7.72728
6.450 9.80956 8.539 0.93140

18) 5.556 .74468 → 5.556 .74468
7.056 .84856 → 6.356 .86654
7.89612 → 7.92804
57.47 1.75944 61.85 1.79136

7.79224 → 7.85608
2046 3.31075 2369 3.37459

7.58448 → 7.71276
6.146 0.78860 8.247 0.96128

197

19) 5.263 .72123 → 5.263 .72123
6.763 .83014 → 6.263 .79678
7.89109 → 7.92445
56.81 1.75441 61.33 1.78777

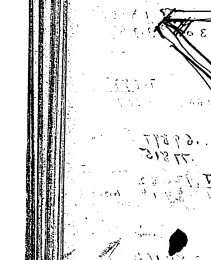
7.78218 → 7.84890
1998 3.30069 2330 3.36741

7.56436 → 7.69780
5.868 0.76848 7.960 0.90192

20) 5. .69897 → 5. .69897
6.5 .81291 → 6. .77815
7.88606 → 7.92082
56.15 1.74938 60.83 1.78414

7.77212 → 7.84164
1953 3.29063 2294 3.36015

7.54424 → 7.68328
5.602 0.74836 7.716 0.88740



Methods of The use of a 99
high resistance for measuring
strong currents

A high resistance differential galvanometer of Elliot Bros has been at my disposal during the last year. With this were resistance boxes containing 60,000 ohms and a box which contained resistances varying from one hundredth of an ohm to five thousand ohms which were used to make a shunt around the galvanometer. The size of the resistance 60,000 ohms

made it possible to measure electromotive force by using various batteries of various strengths in the current and taking the deflection to represent the E.M.F. of the cell by neglecting its resistance. It also made the assumption true that if the ends of the circuit containing the high resistance galvanometer were ~~shunted~~ with any part of the battery placed at the extremities of a resistance where a strong current was flowing not enough

would escape to make any practical difference in the flow. ~~This being the case it will be~~ This the galvanometer readings would denote the difference of potential between the ends of the circuit containing it and for all practical uses in measuring currents may be considered as an Electrometer.

It has ~~several advantages~~ ~~that~~ over this advantage over a thermometer that the wire used could be clean

·090
·868
·958

·958
·958

3000.010 (3131
2874
7260
9584
3024
2874
1470
955
515

3131 times as much Hg. in bulb as in tube

1/3131 in tube as in bulb

175) 760 (4.34
700
600
525
75

1/4.34

3131
434
12524
9393
1252 4
1358854

1/13.588 part of atmosphere

1/1,000,000

13.588) 760.00 (.08

760) 13.588 (18
760
5988

1/18 mm

-1/18 mm

206

1000 000 6.

13588 4.13308

1.86692

73.6 M

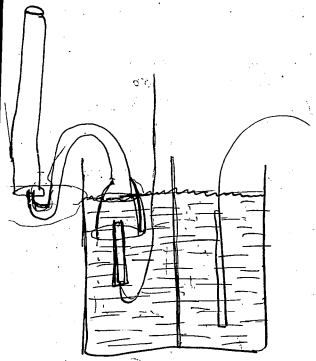
74M

$\frac{75}{175} = \frac{3}{7}$

74

7 | 212

303 m



207

8L

Factor

lamp conductor $ 6.00
lamp .50
dynamo 11.00
2.00

10 lamp per H. P.

1 H.P. costs $110

two 19.50

$20.00 investment per lamp used

200 cents a year

$\frac{2}{3.65} = \frac{1}{1.8)\ 1.00\ (.55}$

100

.55 cts per day interest

Expenses Lubricating 1.5 H.P.
other .5
2.

150 4 hours
11.00 11.00 +7.00 .8
77.00 .65
77.00 11.00 7 1.35 per day
11.00
11.00 11.00 · 39 11.00
11.00 77.00 770 4 ct. per hour

4 hours 15-0 Other lamps
4 hours hours 15 per H.P.
hours
Power will do for expenses
5 1/2 cts per hour
H.P. $11.00

32 1/2 minutes.

1 Weber Chlorine

180 cc.

32.5) 180.0 (55
1625
1770
1625
1450
5

5.5 cc. per minute per Weber

.092 per second

28.5 minutes

1.2 Webers

180 cc

~~1.2 28.5~~

28.5
1.2
570
285
3060

30.60) 180.0 (59
1530
2700

5.9 cc. per minute

The Ch. was freed in an from a carbon plate in an apparatus like this

A decomposition cell
B small pneumatic trough
C a bottle of H_2O connected with B by siphon D so that as the water was emptied from vessel E the

in B would not change

In the first determination there was considerable uncertainty in the deflection.

$$\frac{1}{c'} + c'' = C$$

$$\frac{1}{R'} + \frac{1}{R''} = \frac{1}{R}$$

$$\frac{R'' + R'}{R'R''} = \frac{1}{R}$$

$$R = \frac{R'R''}{R'+R''}$$

$\frac{1}{9}$ $\frac{\frac{1}{10}\times\frac{1}{16}}{\frac{1}{10}+\frac{1}{9}}$ + $\frac{1}{1}$ = $\frac{\frac{1}{10}\times\frac{1}{9}}{\frac{1}{9}+\frac{1}{10}}$ = $\frac{\frac{1}{90}}{\frac{19}{90}}$ = $\frac{1}{19}$

19)1

1 2.7888 418

~~8.9212~~

.5686 362

4655 3706

3098 2840

2676

214

Book 31 page 208

10.1

101
201

2.0043
1.3032
.7011

5.02
.053
500253
15.102

15.102

3.35
.0370
3:387

5.02
.05
5.07
15.07

.70014
.7011
.0003
1.7014
1.1364
.5250

525

.17050
.1783
.5526

3.36

336
.037
13391

253

215

1.5302
1.1264
.4034

91

W W W

1/10 10.39

~~103~~ ~~117~~ 103
~~104~~ ~~118~~ 104

1	103/104	.0128 .0170 .9958	.9916 99.9832
2	99 114/115	.0569 .0607 .9962 .9958 .9920	98.2 .9840
3	126/127	.9965 .9885	.9650 97.4
4	1446/1456	.9970 .9855	96.7
5	1682/1689	.9974 .9829	96.1

6	.9829 .9978 .9807	96.7
7	.9983 .9990	96.3
8	99 87 .9777	95.
9	99 92 .9869	94.8
10	.9996 .9865	94.7

Bank 3% Jones 2 6.0
2.45
1 192

10.1 X10
20.1

2.0043
1.3032
.7011

9542
43
.9499 89.1
.8998 79.4
.7996 63.0
1.2041
1.0037 10.1 Crumbles

9

5.02

5.02 X10
15.07

5.02
.052
5.072
1.7052
.5129
1.7052
1.1781
.5271

8

3.37
.9583
41
.9542 90
.9084 81
.8168 65.6 2.02.09 10.5 Crumbles
9536
53
.9583 90.8
.9166 82.5
.8332 68.1
2.0371 10.9 Crumbles

7

3.37
.037
3.407 X10
13.40
2.54

1.5324
1.1271
.4053

9680
44
.9688 92
.9272 84.6
.8544 71.5
2.0585 11.4

6

2.54
.029
2.569 X10
12.569
2.04

1.4077
1.0944
.3103

.9727
47
.9680 92.9
.8360 86.3
.8728 74.5
2.0769 11.9

220

5

2.04
.025
2.065 X10
12.016
1.71

1.2385
1.0693
1.3248
1.0803
2.336

.9776
.9722
.9454
.8908
2.0949

4

1.71
.022
1.732 X10
11.73
1.477

1.2385
1.0693
.16792

.9837
.16792
.82578
.9776
.9552
.9100
2.11441

95
90.2
81.3
13.

3

1.477
.020
1.497 X10
12.497
1.30

1.1753
1.0603
.1150

97.5 .9890
1.3 .1150
comp 1.378 .8797

.9837 96.3
.9678 92.8
.9348 86.1
2.1389 13.7

2

1.30
.019
1.319 X10
13.19
1.16

1.1203
1.0539
.0664

98.5 .9937
1.16 .0664
comp 1.178 .9289
.9890 97.5
.9780 95.0
.9560 90.4
2.1601 14.5

22

222

1

1.16
.018
1.178 x10
11778

1.0718
1.0488
.0230
.0286
.9937 98.5
.9874 97.1
.9648 94.4
2.1789 15.1

0

1.05
.018
1.0678
10678

~~1.0286~~
~~1.0488~~
~~.0440~~

223

100 $\frac{1}{244}$ $\frac{1}{24}$

9832
2
1.9664
2
.9328
.2041
.1369

1.04 Ohms 6 feet 6 in

6½ feet

104)650(6.25 feet one Ohm

624

260

208

520

75.8

.245

.245 Ohms

18.10 Ohms

1270

.245)18.9.33(

1.2765

1.2765

1.8873

77.1 feet per Ohm

.0182 $\bar{2}.2601$
771 1.8871
.1472
1.4 feet 1ft 5 inches

.0185 $\bar{2}.2672$
1.8871
1.42 1ft 5½ inches .1543

.0192 $\bar{2}.2833$
1.8871
1.48 1ft 6 inches .1704

0204 $\bar{2}.3096$
1.8871
.1967
1.57 1ft 6½ inches

0222 $\bar{2}.3464$
.2335
1.71 1ft 8 inch

.0250 $\bar{2}.3979$
.2850
1.93 1ft 11 inch

.0294 $\bar{2}.4683$
2.26 2ft 3 inch

.0370 $\bar{2}.5682$
2.85 2ft 9 inch

.0586 $\bar{2}.7680$
4.06 4ft ¼ in

101
7.7 7ft 8 inch

~~10 feet~~ 3/2 10

14 feet 4 inches

14 10 inches

15 4

16

16 6 inch 8/2

18 feet

26 feet

~~Feet~~ Inches

1 5

1 5 1/2

1 6

1 6 1/2

1 8

1 10

2 3

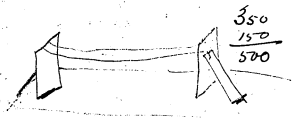
2 9

4 1/2

7 8

182

350
150
250
750



350
150
500

.0041
30
.12230

.0131
30
.3930

.0173
60
1.0380

.0215
60
1.2930

.0249
30
.7470

.0081
20
.1620

.0123
20
.2460

.0265
650

.163
20
3.26

A	30	hours	~~1/4~~ of capture ~~250~~ feet	250
B	30	hours	700 feet	810
C	60	hours	950 feet	1070
D	60	hours	1150 feet	1330
E	30	"	~~1350~~ "	1590
F	20	"	~~500~~ "	500
G	20	"	"	760
H	20	"	"	1920
J	10	"	"	400

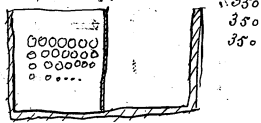
1 ohm
290

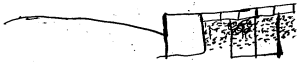
Continuation of the [illegible]

350 350 feet 350
350 feet 350 350 feet

350

350
350
350





2140
1200
940

27.6
60
1656.0

8580
1656
8824 1656 Panel
20

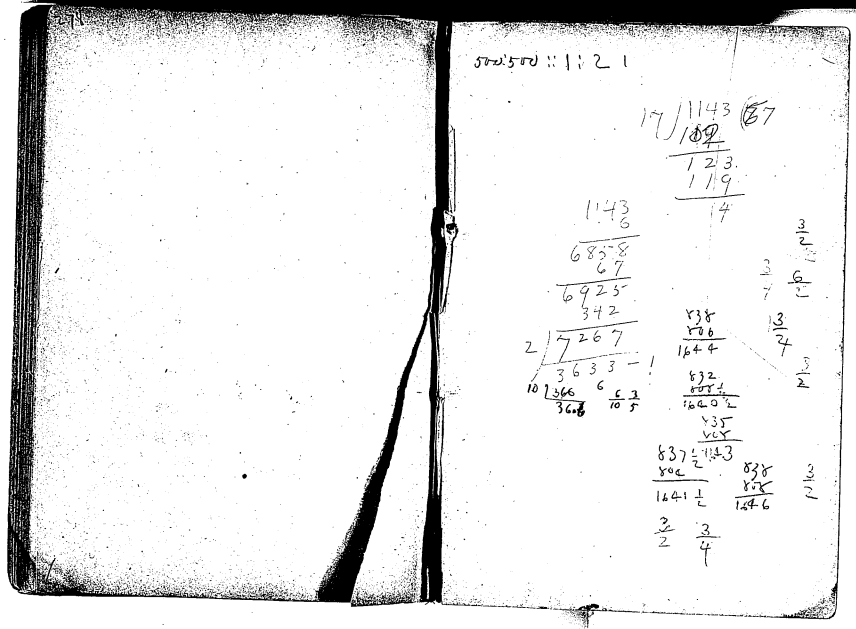
7 Hooks
& drawn
14 Hooks

200
60
260
3
780
130
910 feet

850
2
1600

910
850

910
850



Menlo Park Notebook #29 [N-79-02-15.2]

This notebook covers the period February-October 1879. Most of the entries are by Edison. There are some entries by Francis Upton. The name of Charles Batchelor appears occasionally as a witness. Material by Edison includes drawings of the electric pen; specifications for an English patent on the electric light system, which cover the lamp, regulator, generator, and meter; notes on electricity and magnetism; and drawings of generators. Material by Upton includes notes and calculations from resistance tests on carbon, chalk, and sulphide of molybdenum, as well as calculations and drawings of electric power distribution systems. There are also some hand-drawn maps of Europe, Africa, and the Western Hemisphere at the end of the volume. The label on the front cover is marked "English Patent &c." The book contains 284 numbered pages.

Blank pages not filmed: 20, 23-27, 208-213, 222-225, 230-247, 250-251, 256-265, 272-273.

Missing page numbers: 21-22.

No. 29

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BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

[illegible]

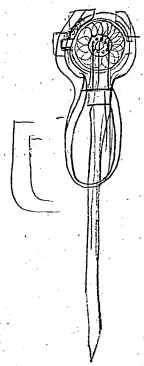
[illegible] N.Y.C.

[illegible], 189[illegible].

No. 29

Feb. 15 - 1879

The Chas Pratt Co



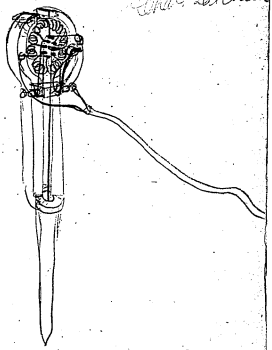
300
15

36
15
180
36
540
36
576

Johnott Feby 15 1879

TAE

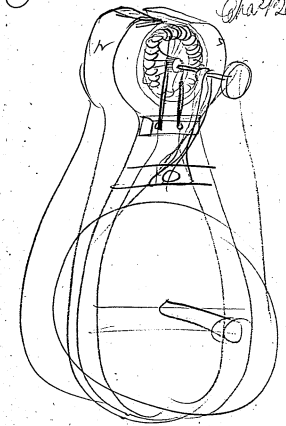
Sketch of telephone



John Ott
to make =

Feby 15 1879

Chas Batchelder



6

12
12

6

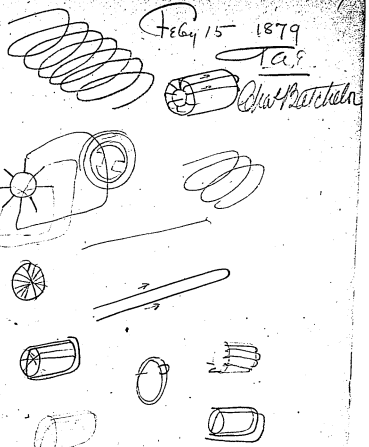
16

12

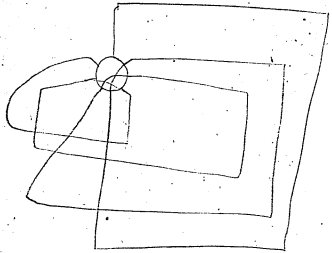
7

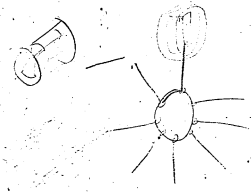
Feby 15 1879

T.a.?



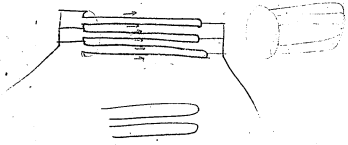
Feb 15 1879



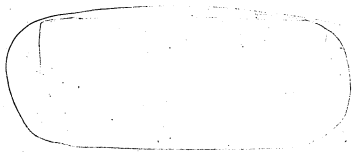


Feby 15 1849

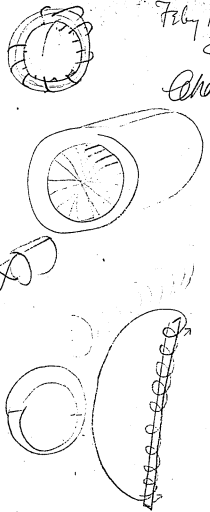
Chas Batchelder



20.



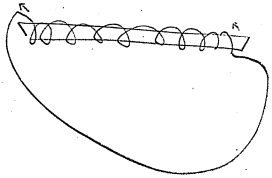
Feby 15. 1879
Tas
Chas Batchelor

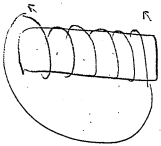


Feby 15 18-19

Ta?

Chas Batchelor

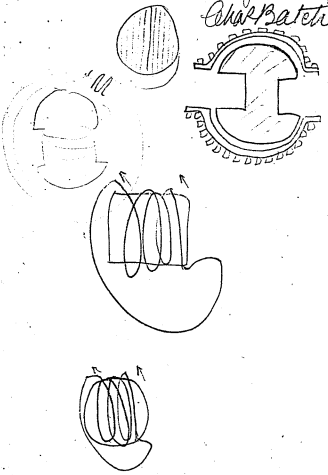




16

Febry 15 1879

Char Batchelor



Oxide of manganese, (gray crystalized)
first used in Vallance Sacc.
by R W Fox, p 300 Phil Mag
1835

Put all your Eggs in one Case
1172.

Preliminary to
Provisional Specification for Improvements
in
Engl. Pat. -

I have ascertained that
When Platina Iridium or other
metallic conductors of Electricity
which that fuse at a high
temperature are exposed to a high
temperature near their melting
point in air for several
hours by passing a current of
Electricity through them
and then are allowed to cool
the metal is found to be crystalline
and under the microscope
there is revealed myriads of
Cracks in every direction many
of which are seen to reach nearly

to the centre of the wire. Hence
~~if I have also discovered that~~
~~platinum or platinum alloyed~~
~~with iridium or metals of the~~
~~platinum group~~
~~if the heat is kept under~~
~~that fusion~~ I have also
discovered that contrary to the
received notion platinum or
platinum & iridium alloy
~~loses~~ weight when exposed
to the heat of a candle
that ~~when~~ heated air causes
it to lose weight, that the
loss is so great that it
~~exceeds~~ tinges a hydrogen

flame Green, and under
the influence of an electric
Current ~~[illegible]~~ and at a yellow
white heat the loss is very great,
after a time the metal falls to
pieces, hence ~~[illegible]~~ wire or sheets of
platinum or platinum + Iridium alloy, as now known as Osmiridium
are useless for giving light by
incandescence ~~[illegible]~~ 1st because
the loss of weight makes it
Expensive, 2nd unreliable and causes
the lamps to be rapidly destroyed
2 because its electrical resistance
changes by loss in weight
and its ~~[illegible]~~ light giving power

for the total surface is greatly
reduced by the cracks or ruptures
the melting point being determined
by the weakest spot where
the greatest difference of
potential of the Electric Current
is present which ~~abnormally~~
~~heats it~~ causes this point
to be brought to a higher heat
than the rest of the surface
of the wire again as it
is essential to obtain a steady
light the platinum Current
must be screened from the
air, and when thus screened
by being placed in a

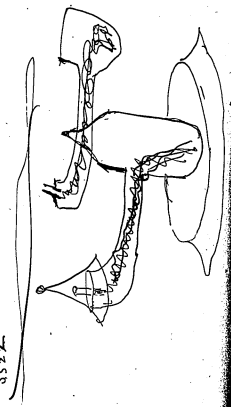
glass vessel the glass soon 39
becomes coated with a
black deposit of platinum.

~~[redacted]~~

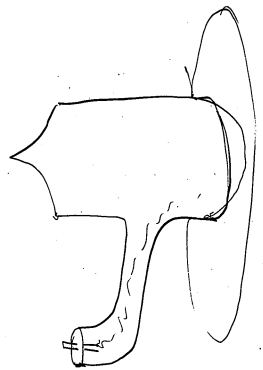
A. platinum ~~[illegible]~~
Spiral. brought to incandescence
under these conditions may
be made to give a light of
three ~~spm~~ standard
candles when near its
melting point & when the
radiating surface is
3/16 of an inch, but this
amount of light will be
gradually reduced as
before described.

I now come to that part which
Constitutes my discovery and
invention.

I have found that the cause
of the rupturing of the metal
when brought to incandescence
is due to the expansion of the
gases contained both in the physical
pores & also in the mass of the later ✱
an Being probably placed
there in the act of drawing
the wire or rapping the Ingot
Now this air when subjected
to these high heats greatly
Expands and ruptures the

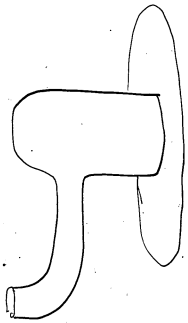


metal, and it cannot be driven out by slowly heating as it is soon absorbed. I have also discovered that the loss of weight and apparent volatilization of the metal is due entirely to the attrition of the air molecules against the highly heated surface. Having thus ascertained the cause of fracture & loss of weight I have conducted Experiments to obviate these

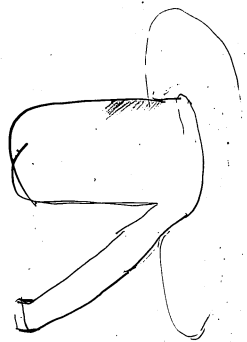


effect and have succeeded by the following method.

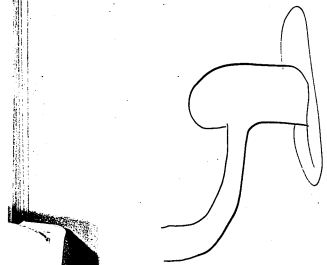
~~A~~ a spiral of platinum wire ~~is~~ placed in a glass bulb with its ~~ends~~ passing through & sealed in the ~~and connected to the source of electricity~~ and the air Exhausted from the bulb by a sprengel pump until the ~~spot~~ discharge from a three inch Induction Coil will not pass between subsidiary wires in the bulb 4 millimetres apart. the wires of the spiral are then connected to Magneto Electric machine or Battery



whose current can be
controlled by the addition
of resistance, ~~a sufficient~~
quantity current is allowed
to pass through the wire
to bring it to about ~~300~~ 150 deg
Fahr ~~it~~ it is allowed
to remain at this temperature
for 10 or 15 minutes, while
thus heated both the air
mechanically mixed in the metal
by drawing or rolling as
well as that in the physical
pores is expelled on the one
hand by heat + on the other



hand tends to pass outward
to equalize the pressure,
which this air or gases is passing out
of the metal the mercury
pump is kept continuously
working. after the expiration
of the 15 minutes the current
passing through the metal is
augmented so that the
temperature will be about
300 degrees fahr, and it is
allowed to remain at this
temperature for another
ten or 15 minutes, when



If the mercury pump be worked
continuously and the temperature
of the spiral ~~greater~~ raised
at intervals of 10 or 15 minutes
until it attains ~~to~~ to vivid incandescence
and the bulb be then sealed
we then have the metallic
wire in a state of ~~incandescence~~ incandescence
for it may have its temperature
raised to the most dazzling
incandescence emitting a light
of 25 standard candles whereas
before treatment the average
melting point of a number
of the spirals having of the
same length & size of wire

and having the same radiating
surface was cut 3 standard
Candles, - The wires ~~of the~~
Vacuum subjected to the
process of ~~excluding~~ freeing
them from air, are found after
the process to have a polish
exceeding that of silver and
obtainable by no other means, ~~if~~
no cracks can be seen even
after the spiral has been
suddenly
raised to incandescence many
times by the current and no
Volatilization takes place
as there is no deposit upon
the glass bulb, nor does ~~the~~ a

Delicate balances show any
loss of weight after 6 months
for many hours continuously
because if the spinal is in
high vacuo the attrition of the
gaseous molecules is reduced
to the minimum and were it
possible to obtain an absolute
vacuum there could be no
loss whatsoever. Even with
the residual gas the total
loss after a year was
loss worked scarcely be noticed
I have further discovered
that if an alloy of platinum
or even platinum
& Iridium be coated with

56

57

the oxide of magnesium ~~by~~ in the manner hereinafter stated. And ~~brought~~ subject to the vacuum process described ~~that~~ Combustion takes place between the metal and the oxide ~~is~~ giving ~~the said~~ the former remarkable properties With a spiral ~~of the same size as that of platinum already described~~ having a radiating surface of 3/16 of an inch. light equal to that given by 40 standard Candles may be obtained Whereas the same spiral as of

passed through Mag process
would melt before giving
a light of 4 candles
The ~~light~~ effect of the oxide
of magnesia is to harden the
wire to a surprising extent to
render it more refractory
and A spiral spring made of the
wire ~~loses~~ is just as elastic
when at dazzling incandescence
as when cold =
~~I have~~ I have found that
pure iron drawn in wires
and subjected to the vacuum
process may be made to
give a light equalling that

of platinum in the open air
& not subjected to the vacuum
process =
Carbon sticks may be also
freed from air in this manner
and be brought to a temperature
that the carbon becomes pasty
and if then allowed to
cool is very homogeneous &
hard = rods or pellets made of
mixtures of finely divided
conducting & non-conducting materials may thus
be freed from air,
It is also obvious that
the metal might be heated
by subjecting the carbon
bulb to a considerable

temperature but this does not produce but particularly free the wire,

I will now describe the form of burner or lamps which I propose to use, ~~To obtain practically submitted Sabbeton will be able to bring to~~ To obtain practically several hundred Electric lights each equal to the ordinary gas jet upon one circuit / It is essential for many reason both on the score of Economy, facility,

reliability to place them all in Multiple arc and to prevent the combined resistance of several hundred lamps from falling to such a low point as to require a much Conductors of immense dimensions, and machines of with low resistance Corresponding Characters. It is Essential to remove the present unusual practice of having lamps which have but one or two Ohms resistance and constructed lamps which should have when [illegible] giving their proper light

of several hundred ohms
I have ascertained by
Experiment. ~~[illegible]~~ that
the loss of energy is in proportion
to the extent of the radiating
surface & independent of
the resistance of the conductor
hence whether we
have 1000 lamps each of
$\frac{1}{4}$ of an inch radiating surface
& each of 1 ohm resistance
or 1000 lamps having the
same radiating surface &
1000 ohms resistance each
the loss of energy from each
lamp when giving a light

of 15 candles will be the same. But the combined resistance of the 1 ohm lamps will be $\frac{1}{1000}$ of an ohm requiring an enormous main Conductor - whereas the Combined resistance of the 1000 ohm lamp will be 1 ohm requiring a Conductor of very moderate dimensions. In practice a resistance of 200 to 300 ohms in the burner will be sufficient, again with lamps of low resistance the lamp connections & leading wires must be large to prevent great loss of Energy

by resistance, the leading wires from the mains conductors are large & Expensive & bulky to handle, the low resistance of the burner ~~requires the large~~ or incandescent conductor requires large terminals to convey the current and these ~~offer~~ offer by their conduction a medium for the rapid dissipation of Energy without producing any Effect whereas with a lamp of high resistance the lead wires from the mains

12

75

~~Each flame may be~~ ~~of the~~ all these objections are obviated! =

My burner consists of a Gabbin ~~Gabbin~~ composed of an infusible oxide ~~Gabbin~~ such as oxide of Calcium Cerium Zirconium, Magnesium, ~~freed from Silica~~ & turned in a lathe to proper shape freed from Silica moulded by hydraulic pressure in a manner hereinafter set forth

This Gabbin is shown in fig 1

It is seemed to two platinum wires as in fig 2

fig 2

These wires serve to hold the bobbin in the centre of the sealed glass vacuum bulb and at the same time serve as conductor of the Electric Current to the wire coiled upon the bobbin

Fig. 3 shows the manner of connecting the wire upon the bobbin to the platinia supports

fig 3.

The bobbin is sealed in the vacuum bulb as shown in fig 4.

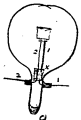


fig 4

The two platinum wires 1 & 2 are

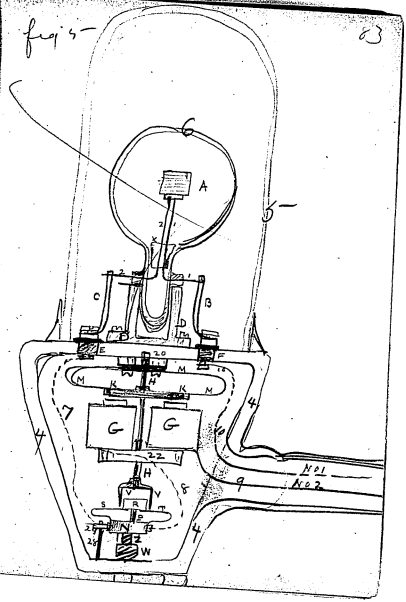
first passed through a small
tube of glass x which is softened
around the wires, the ~~bobbin~~
wires 1 & 2 pass out through the
sides of the narrow tube leading
from the bulb and are sealed
to prevent leakage by having
smaller glass tube softened upon
the wires bent at right angles
which tubes are sealed to the
glass of the bulb =
Before the burner is permanently
sealed at g. before being taken
from the air pump the wire
upon the bobbin which previous
to winding thereon has passed
through the vacuum process
hereto fore described is brought

to incandescence for about one hour to heat the bobbin and thereby expand the air, whereupon the bulb is permanently sealed & is ready to be placed in the lamp = This is shown in fig 5—

82

fig 5—

83



6 is the bulb containing the burner. A supported by the platinum conducting wires 1 & 2
The bulb lays in the socket D the extremeties of the conducting wires 1 & 2 are connected by Copper wires to the insulated Clamping Screws E & F.
5 is an outer glass vessel to prevent injury to the Vacuum bulb, this may take any form such as an opal shade, large bulb -
G is an Electro magnet having a resistance of but a fraction of that of the lamp. and serves to

regulate the ~~amount~~ total energy consumed or given out by the lamp than it does by being adjusted in such a manner that it will serve to disconnect the lamp from the circuit should the current increase materially from any cause beyond what is necessary to produce the normal amount of light. The magnet ~~coil~~ ~~is practically cutting~~ is ~~also~~ in the same circuit as the incandescent conductor of the 6-66 Cm. A. The lamp being in multiple arc where alone this form of

regulation is admissible
the current passes from
wire No 1 to post F thence
via B to the wire 1 to the
bobbin A through its wire to
wire 2 thence via C to the
post E via D to the central spring
S through R to the spring
T thence to the left to
the magnet G & from the
right of magnet G. via
wire 9 to No 2 wire.
The circuit admits of being
broken by the effect of the
attraction of the armature
K which is secured upon
the work spring M.
the upper part of which

is secured to the base of the lamp fixture, connected to the armature is a rod H which slides in bearings at 20 & at 22. so that the motion of the armature to & from its magnet gives the rod an up and down movement, upon the lower end is secured a Cup V. whose periphery comes to come in Contact with the springs S. & T. and seperate them from the metal disc. R. which is secured to the disc of insulating or non conducting material N (to which the springs S & T are secured) by

a pin .P. a pin 28
"passing through a hole in
a projection 29 from N
serves to prevent the latter
from turning when it is
adjusted upwards or downwards
by the double threaded
screws 2.4.2. by means
of the latter the springs
S.4.T may be brought in
so close a proximity to the
Edge of the cup .V. that
a very slight current
passing through the magnet
G will attract its
armature sufficiently

to cause a downward motion of the Rod H & seperate the springs S.T. simultaneously thus opening the circuit in two places simultaneously of the object of which will be explained. By this adjustment the magnet will continue to vibrate automatically with great rapidity but ~~very feeble~~ quite noiselessly when the case is closed, in this Condition ~~no motion of the Circuit~~

~~with all~~ only a certain
amount of energy will
pass to the lamp and if the
Current is increased while
this adjusted the effect
will be only to increase the
amplitude of the vibrations
reducing the closeing of the
~~the~~ Circuit shorter. so that
in a given time the total
Energy will be about
the same whether the
Current is strong or weak
If now the disc N is
adjusted downward

more and more current will pass to the lamp as the amplitude of the oscillation of the magnet is thus decreased until it reaches a point where the power of the current is insufficient to energize the magnet to such an extent as to overcome the constantly increasing power of the Circular Spring M. and separate the Springs S.T. from R. If the Tensions of the current are properly regulated, the

lamp will give its
normal amount of light
and the springs S.A.T will
be in such proximity to the
Edge of the cup V. that
any abnormal accession
of current from accident
or otherwise will cause
the latter to Separate the
springs S.A.T & prevent
further rise of temperature
in the burner A. And it
will continue to vibrate
as long as the abnormal
flow of current continues

& falling back to a
quiescent position when the
current is at its normal
strength, as there is no
difficulty in keeping the
temperature of a 16 candle
power burner within the
limits of 12 to 18 candles
the regulator ~~coil~~ may be
set ~~at 18 candle~~ so as
to vibrate & reduce the
total energy when the
current reaches a point
sufficient to produce a
light equal to
18 Candles

The main object is to produce
even illumination and ~~not~~
~~particularly~~ afford a method
of increasing & decreasing
the amount ~~below~~ from a
certain limit to any lesser
amount & not particularly
to prevent the fusion of the
incandescent Conductor Because
~~the~~ in practice ~~Carbons~~
I shall not have the
burner give more than a
light equal to 16
Standard Candles
whereas it will give

forty without fusion,
~~[illegible]~~ when
it is desired to disconnect
the light altogether the
upward movement of N,
in the act of turning out
the light ~~a little more~~
reaches a point which is
the normal position of the
armature magnet hence
the springs S & T are
forced against the edge
of the cup V and the
circuit is permanently opened

~~heretofore it has been~~
~~difficult to obviate the~~
~~spark due to the break in~~
~~the circuit when the lamp~~
~~is disconnected. with [illegible]~~
~~to the [illegible]~~

With lamps worked in
series. I have regulated
the temperature by thermal
regulator which served
to operate devices which
shunted the burner
and gave a new current

for the passage of the
Energy. Regulators worked
in this manner are very
little troubled with sparks
at the contact points, as
lamps of low resistance
may be used and the
difference of potential
is very small, ~~and the~~
But when lamps are
to be worked in multiple
arc it is essential that
the lamps should be
disconnected entirely

from the circuit but intervals
following each other with
some degree of rapidity -
and with dynamo Electric
Machines where the field
magnet is secured by
the system of reciprocating
accumulations, the break
in the circuit causes
the latter to discharge
and or when many lamps are
used to reduced ~~to~~ in
strength for an instant
& thus gives a very
powerful spark

suffecent to fuse the
platinum Cattical springs
apoint by producing a
momentary arc, by dispensing
with the variable field
magnet ~~& contacts~~ &
Coil. Excluding it from
the circuit, and energizing
it by Extraneous Energy
the spark is so rendered
as to be instantaneous
~~& hot~~ being proportionable
to the discharging time of
the induction Cylinder of
the Magneto Electric.

generation notwithstanding
the fact that the spark is
small I have found that
time brings out a defect
not at first perceptible which
is that the action
of the spark as in the Electric
arc causes a small point not
larger than a needle to shoot
out from one of the platina Contact
points and although the Contacts
are still as perfect as at first
the Effect is to change the
relative position of the
point of contact
& thus alter the adjustment

I have devised a
method of obviating
the sparks reducing the
between contact points
sparks from a strong current
of great electromotive
force such as that given
by a dynamo machine
or short circuit between
metallic points, to a point
almost imperceptible and
without the consumption
of energy by the use of
resistances or other
devices heretofore
used for such purposes

This device is applicable to all kinds of Electrical appariatus ~~[illegible]~~

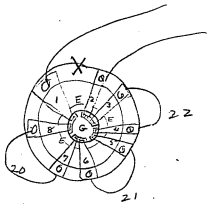
~~[illegible]~~

~~The~~ 91 is known that the resistance of the spark in the Electric arc as well as between metallic points decreases with the increase of energy; hence the spark between a pair of single points will have 4 times the fusing power as when the same circuit is broken simultaneously

at two different points,
and in a corresponding ratio
for every additional point
where the circuit is broken.
The difference of potential is
reduced in the resistance
increased. Thus when
a spark between platinum
terminals is 2 inches in
length. The same may be
reduced so as to be invisible
in daylight. If the circuit
is broken simultaneously
at twelve different places
in the circuit.

and to obtain a simple & cheap device for this purpose I have devised the mechanism shown in fig

fig. 6.

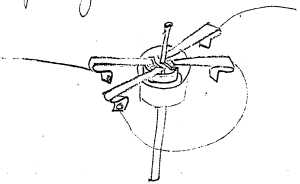


X is a ring of insulating material such as Vulcanized rubber

1 2 3 4 5 6 7 4 8 are
Conical springs of steel or
other Elastic metal tipped
upon their ends with Iridium
platinum or other unoxidizable
metal - The ends of 2 & 3 rest
upon a metallic sector inlaid
or resting upon the vulcanite
disc G which is also
of non conducting material.
These sectors are 4 in
number 4 & 5 [illegible] upon
the 2nd Sector 6 & 7 on the 3rd
& 7 & 8 on the Last,
These sectors serve to
connect the springs together
The circuit for which
these devices are to

acts for opening &
Closing Entries say spring
1 passes across the Secta
to spring 8 via wire 20 to
Spring 7. Thence via Secta
to spring 6. via wire 21
to spring 5 Thence via
Sector to Spring 4 thence
via wire 22 to spring 3
Thence via Sector to the
Spring 2. to the other
End of the Circuit wire,
when the springs are all
in Contact with their
Sectors the Circuit is
Complete, ~~by means of~~
~~If the Key~~

~~if the~~ edge of the ring
is brought against the springs
E. ~~the~~ all of the springs
~~may be separated~~ are
separated from their sectors
simultaneously and the
circuit is broken in 8
different places simultaneously
fig. 7. shows the
arrangement with 4
springs



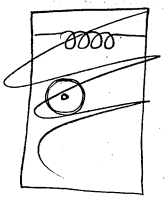
Having now described my Lamp I will describe the devices which I propose to employ upon the premises of the Consumer for measuring the energy consumed in a given period and to provide against accidental crossing of the Conductors leading from the mains,

for measuring the ~~sume~~ energy
Consumed I place in a
box along with other devices
a cell containg two Electrodes
~~one of~~ of Copper one of
which is the cell itself and
the other a hollow rod
~~which is in this~~ placed
in the centre of the cell.
a ~~[illegible]~~ which I
fill with a neutral solution
of Cupric Sulphate,

~~Could~~ the amount of energy consumed being ascertained by weighing the ~~deposit~~ central rod at ~~the~~ any given interval of time, as these rods are of very little weight and the amount of Copper deposit may be due to any fractional part of the total energy passing still be very accurate it is obvious that for this purpose the dense

is extremely practical as the rods may be numbered and may be carried to the central office by a single inspector to be weighed and returned or others substituted when taken out.

The arrangement of the circuit for passing but a fraction of the energy consumed is shown in fig 8



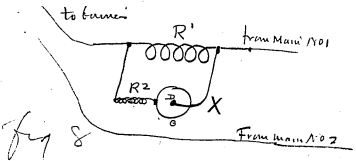


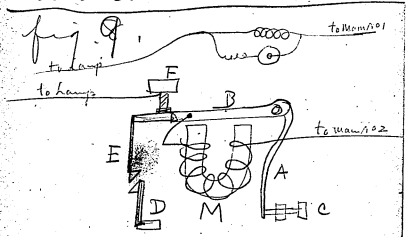
fig 8

X is the Copper Cell D the central Electrode. R. a Resistance but the fractional part of an ohm. R2 a resistance of several ohms R2 the Cell. X.

obtained energy by forming a
derivation from R' - The Resistance
of R' will depend upon the
number of lamps whose
Energy Consumption is to be
measured, Only an infinitesimal
loss of energy occurs by the
interpolation of the resistance
R' R2 + call as the
resistance of R' may be
but $\frac{1}{100}$ of the total resistance
of all the lamps combined &
still afford reliable measurements
with one lamp —

R2 is for the purpose of causing any change in the resistance of the cell to become a small factor in the calculation. In the same box I place a device which I call a safety magnet, the device is shown in

fig. 9.



The object of this magnet is to ~~open the circuit~~ disconnect the premises from the mains should the leading wires ~~from~~ to the lamps be accidentally crossed or get in Electrical connection other than through the 6 ohms of the lamps, the crossing of the wires would tend to draw a powerful current from the mains ~~and~~. ~~If~~ the liver - B - is so adjusted by the ~~spr~~ retractile Spring A

by means of the screw C. ~~that the~~ current will be insufficient to cause the magnet to attract ~~the~~ lever when all the lamps are in but any great accession of current such as would follow if the leading wires to the lamps became crossed the magnet would then be powerful enough to attract B. as the lever B & bridle centred point E form part of the

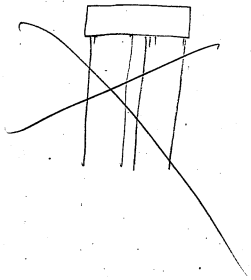
Circuit the circuit will
be opened, & the lever
is prevented from vibrating
by the downward movement
of B causing the catches
E & D to lock together

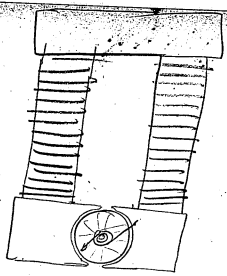
The method of generating
the current will now
be explained, & I have ascertained
by means of the Dynamometer
for measuring energy applied
in foot-pounds and by the Electrical measurements
for Energy obtained in the
Electric form reduced to

foot pounds that the
practice of making the leads
wires & lamps composing the
External resistance Equal
to the internal resistance
of the machine although
the most Effective for obtaining the maximum current, but is
by no means so economical
as when the External
resistance are many times
the internal resistance of
the machine Especially
with machines which have
a constant field magnet

Second that great economy
is attained by increasing the
Electromotive force of the
current by the use of powerful field
magnets in lieu of high
speed of the induction
cylinders or rings, such ~~magnets~~
being kept up by external energy
3rd The use of ~~abnormal~~ field
magnets ~~[illegible]~~
~~[illegible]~~ of great mass, The Machine
~~[illegible]~~ which I propose to use
is shewn in Fig 10

~~10~~





Make good drawing

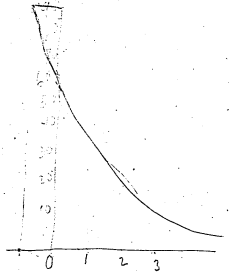
~~Davis~~

Sewell is preparing
the Dynamo patent now
wait for drawing -

~~All~~

To follow in the patent
figs. from Caveat 89 —
1. 4. 7. 8 9 10 11
12 13. 14. 16.
15. 17. 19. 20

+ close the patent



Carbon 3/4 inch
1120 Ohms
Oct. 17, 1879.

Sulphide of Molybde-
3/8 tube 1/2 mid ring

20.000 Ohms

This can be used for
obtaining very high resis-
tance in small space.
Lawson brought some Sulphide
of Molybdenum prepared by
another process which is
powdered under weight & use
2 Ohms in place of 6000
Ohms of resistance first in
tube.

Natural Sulphide of Molybdenum almost an insulator

Bituminous coal almost insulator

Black oxide Manganese

1/2 inch 3/16 tube

14000 Ohms

1/2 Chalk

1/2 lamp black

25,000 Ohms

3/4 inch 3/16 tube

166

Resistance of coils 8.79 167

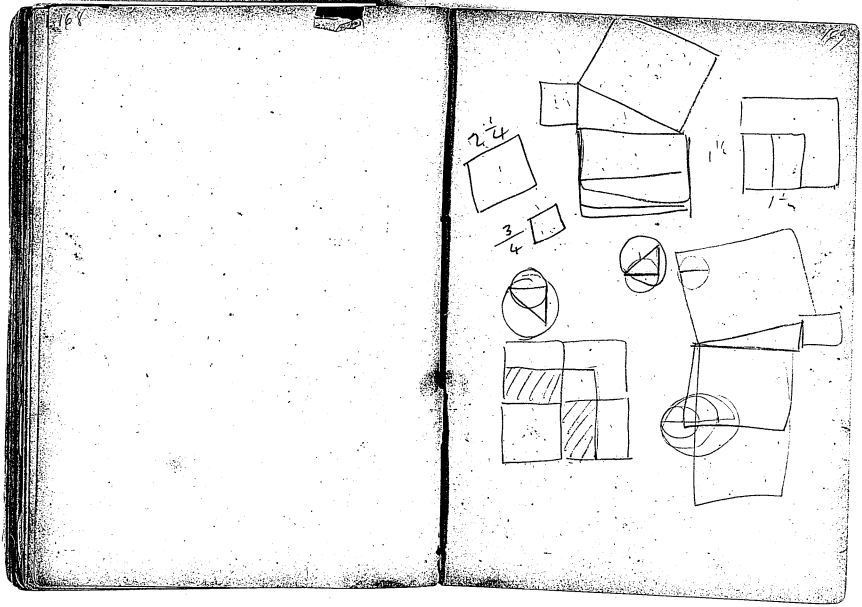
2 grms. Chalk
1 gr. Eddy's Lampblack
mixed in mortar and
packed hard 1800 Ohms

2 1/2 Grms. Chalk
1/2 gr. Lampblack
12500
9500 Ohms
Afterwards no reason 28,000

5 grms. Chalk
1/2 gr. Lampblack
32000 Ohms

8 1
70000 Ohms

again 30000 Ohms
Well ground and hard


2 1/4
3/4
1/4

1,000,000 Ergs = 1 Meg Erg

1 000 000 000 Ergs = Erg nine

= 7.46 H.P.

= 1000 Erg nine meg Erg.

1 Meg Erg = .00746 H.P.

33.000

2238

2238

246.18000 ft lbs

246	2.3909
550	2.7404
	5.1313

135000

$\frac{1}{981}$ Gramme

1000 Ergs = $\frac{1000}{981}$

1 Erg = $\frac{1}{981}$ .9917 / .0083

1.018 Gramme Centimetre = 1000 Ergs

1018. Gramme Centimetre = Meg Erg

= 10.18 Gramme Metres

= .01018 Kilo Metres

$\bar{2}.0083$ $\bar{2}.0083$ / 8593

$\bar{2}.8676$

.0737 foot lbs in Meg Erg

1 Erg = $\frac{1}{981}$ Centi Gramme

1000

423 / 61.6

Megaerg 10 G. M.

$\frac{1}{100}$ $\frac{1}{1000}$ Kilo M.

$\frac{7.23}{100\ 1000}$ = .723 ft lbs

Megaerg = 10 G. M

= $\frac{1}{100}$ Kilo M

= $\frac{7.23}{100}$ ft. lbs = .0723 ft lbs

1 Erg = $\frac{1}{981}$ Gr Centi

1000 Ergs = $\frac{1000}{981}$ Gr Centi .0083

= 1.019 Gr. Centi

1,000,000 Ergs = Meg Erg

= 1.019 Gr. Cent

= 10.19 Gr. M.

= .01019 Kilo. M.

= .0737 about Ft. Lbs.

1000

~~.1012 g Gr. M. S.~~

~~1000 .1012 g Gr. Centi. Sec~~

Gr. M. S = 10000 Gr Centi. Sec

= 100 Ergs = .1012 g Grammeter

= .1012 g X .00723 Ft. Lbs.

7.00828
3.85937
4.86765 7

= .0007371

1,000,000 Ergs = .7371 Ft. Lbs.

Meg Erg = .7371 Ft. Lbs

5530
132
4980 lbs
16
29880
4980
79680

1000 S.C.F. =

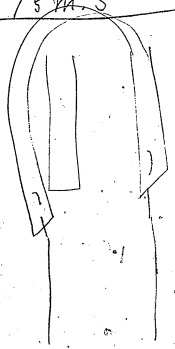
2¼ 1/4 inch 26000

4½ 26000

1/8 in

156000

10000 S.C.F. = 18 ~~Pts~~ S



10000 G.C. S = 1 G.M.S.

101296

Twenty 1250

60 / 1000 / 16
60
400
360
40

Twenty 1250
Twenty
Twenty thousand
5000 Thousand

1.6 per hour per Rp.

Twenty Twenty 60. Twenty
1.5 Twenty 150.000 41.

5.

41 / 1000 / 24.365 / 15000 / 41.
82
180
164
16.
84.

84

250,

95000.

200.000.

60, 15-00

32

10.000. 10, 15- per hp.

2' 10.

60 / 200. / 3
180
20
10.

3000. 200 / 600 16-00. 5-

1

200 000
30
6,0,0,0,0.00

200
30
6000

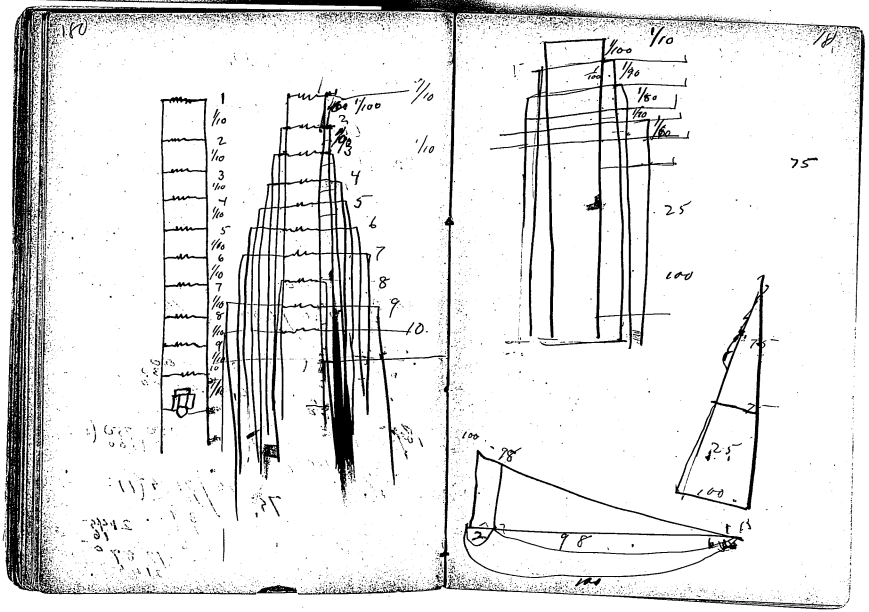
1845

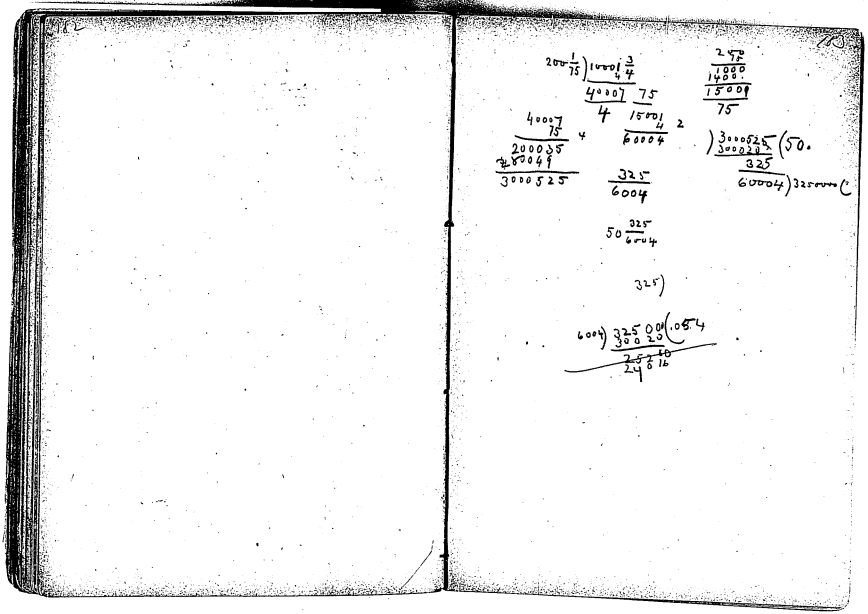
30, 250 / 750 / 3
500

1845,

11. 75, 18 / 2145 / 11
18
34
18
165
2145
16
12870
2145
0
3432

16,


180
1/10
1/100
1/10
1/10
1/100
1/80
1/60
1/60
75
25
100
75
25
100
98
98



50.054 / 1

150.013 − 75 = 75 ; 75 / 100 / 75 / 25 / 4 / 75 / 400 (.0)

50.054 / 1 × 7504 / 75

50.054

50.054

74 / 74 / 296 / 5476 (1, 2)

1 / 5476 × 37 / 74

1 / 5476 × 37 / 1

37 / 5476

74 / 5476

50.054 + 150.013 = 5476

5476) 74000 (.013 ; 5476 ; 23240

50.054 + 150.013 = 150.067

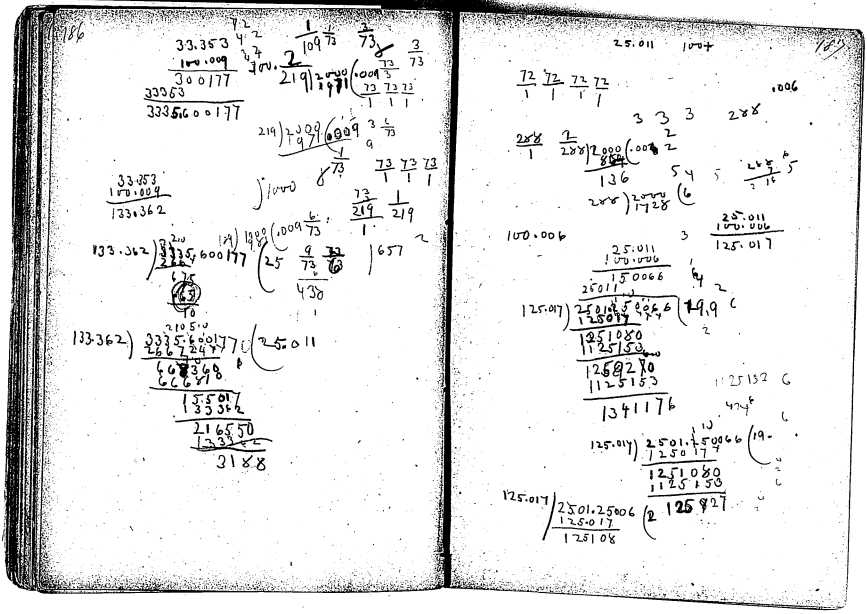
50.054 + 150.013 = 150.0162 ; 50054 ; 5006.0502

5006.0587 (2)

150.067) 5006.0501 (2) (3)

150.067) 5006.05100 (33.353 ; 45020 1 ; 5066 41 ; 4502 01 ; 5636 400 ; 4502 01 ; 1134 990 ; 1050 335 ; 84 650

3



125.017) 2501.25 00 60 (20.00
2500 34
00 910060

25.011
100.006
125.017

72) 2000 (.027
144
560
504
56

25.011
100.006
150066

1/.027

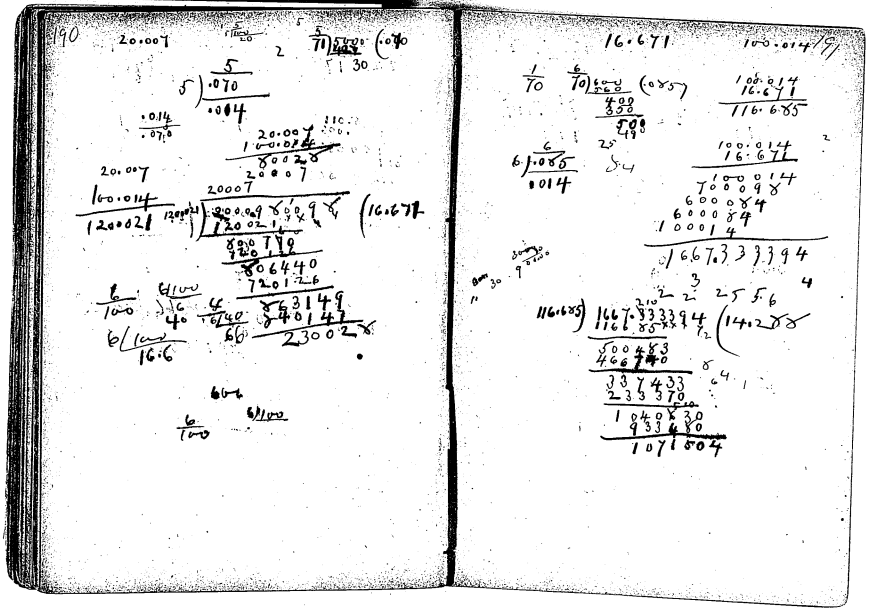
4/.027
.006

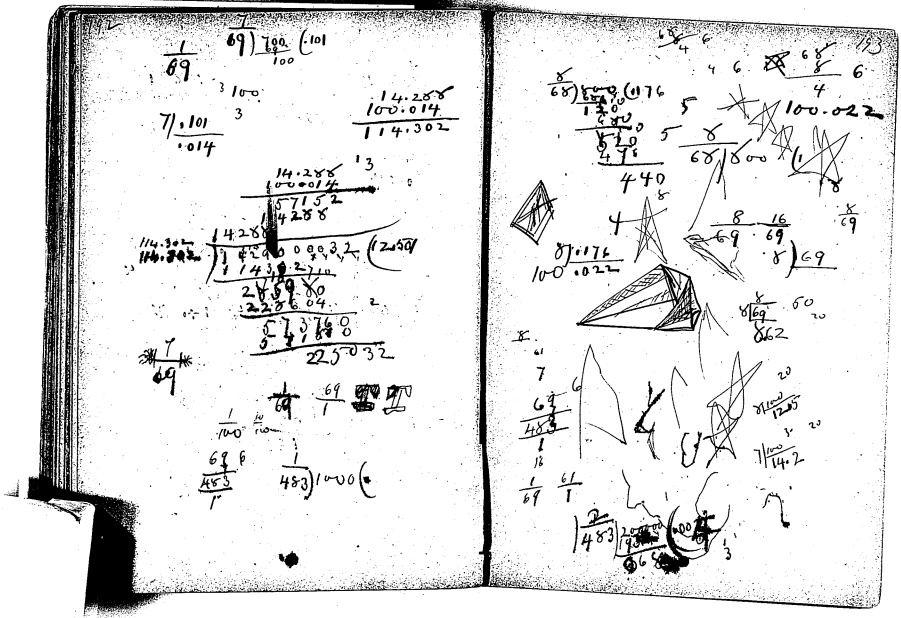
25011
2501.250066

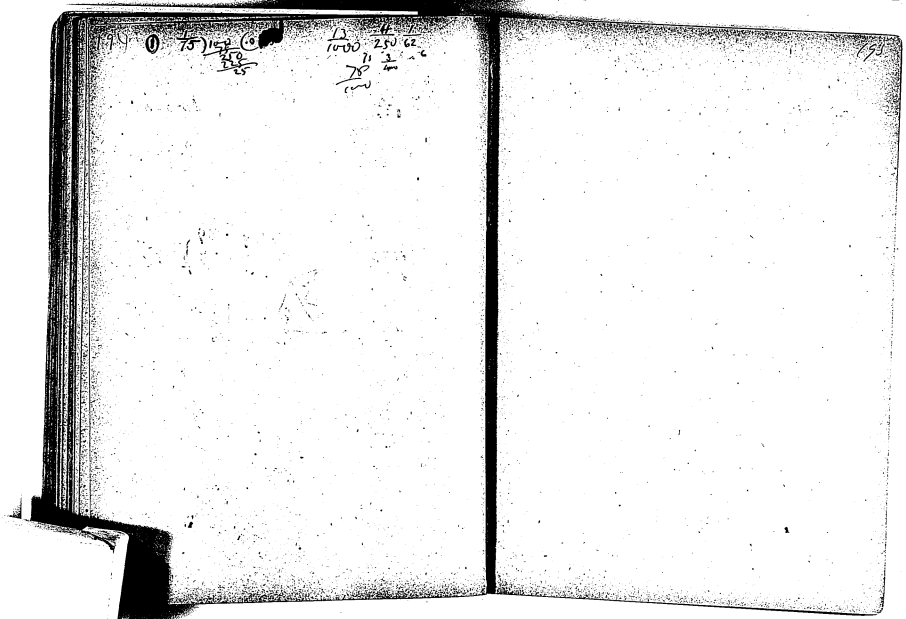
125.017) 2501.250066 (20.007
2500 34
910066

125.017) 2501.250066 (20
2500 34
910066

125.017) 2501.250066 (20.007
2500 34
910066







(1) $\frac{1}{75}$ $.013 \times 2 = .026$

(2) $\frac{1}{74}$

$\frac{2}{74}$ $\frac{1}{100} \cdot \frac{100}{100} \cdot \frac{100}{10}$

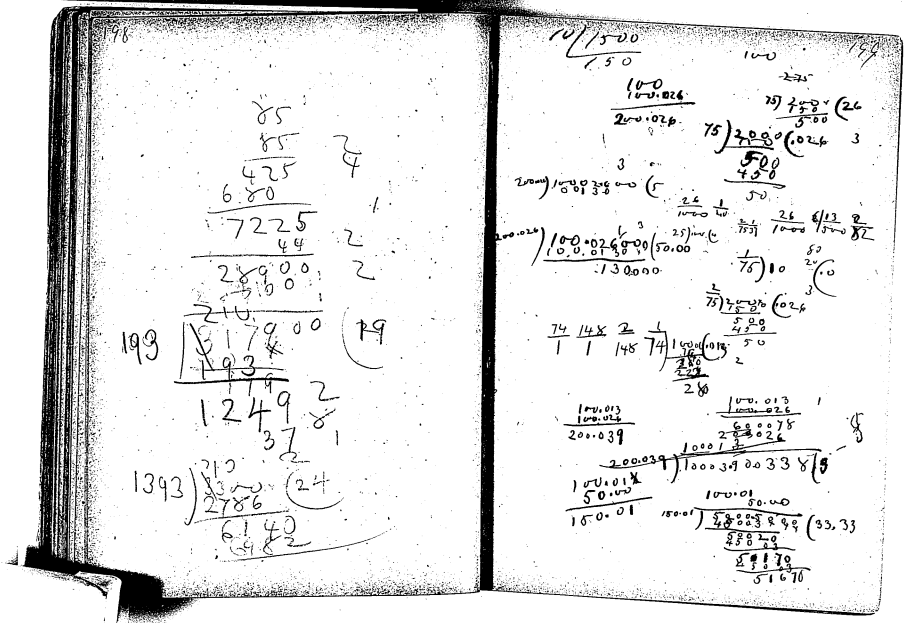
$\frac{1}{74}$

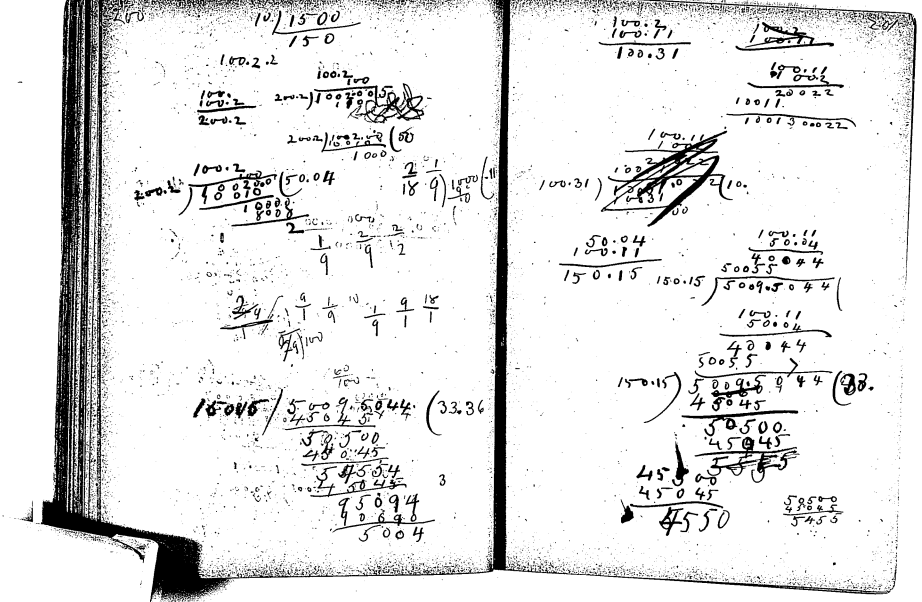
$\frac{74}{1} \cdot \frac{148}{1}$

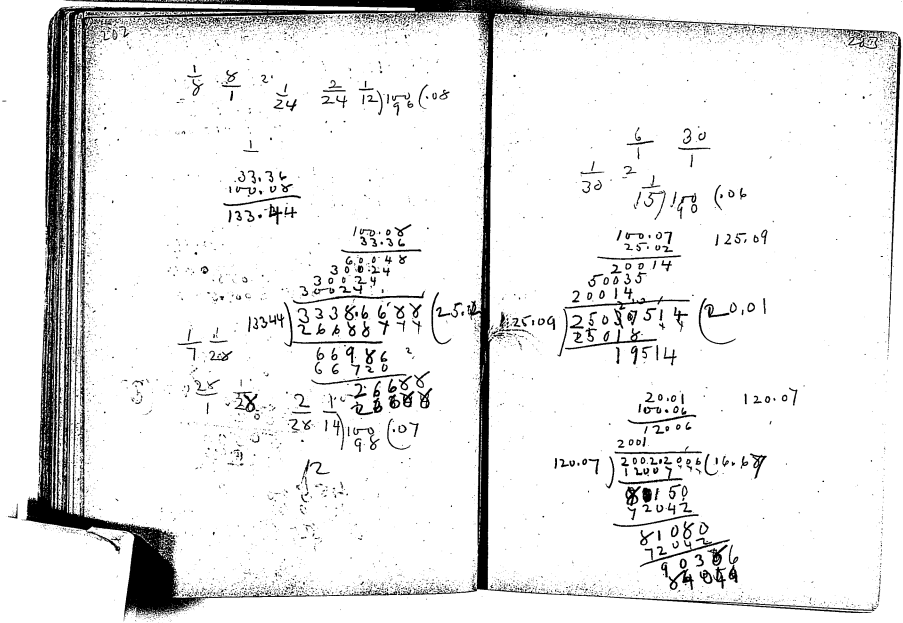
$\frac{74}{1}$ $\frac{1}{74}$ $\frac{74}{1}$

$\frac{148}{1}$ $\frac{73}{219}$ $\frac{2}{219}$ $\frac{1}{109}$

$2/\frac{2}{148}$ $\frac{1}{74}$ $\frac{1}{74}$







$\frac{1}{5}$ 50

400

280 20

93

93

279

837

8649

44

345 96

345 96

480 | 38056

~~98~~

93

10

83

83

250

93

375

187

310

237 | 50 | 93

50

237 | 4650 | 20

064

73

73
73
219
511
5329
44
21316
21316

375 | 2 3 4 4 7 6 | 626
2250
0947
710
2376

626 | 33000 | 52
3130
1700

73
73

10 cells on 73.

10 / 73 /

73

7

74
74
37.5
5.25
562.5
44
2250
22500
247500

50) 247.500. (4950
200 7
475 34650
450
250
250
0

6 1/2

10 7.3
20 7.3
140 146
73

490

6 4950.

20 Res 7.3

20.

10 Cells on 7.3

7 1/2

247.500.

55

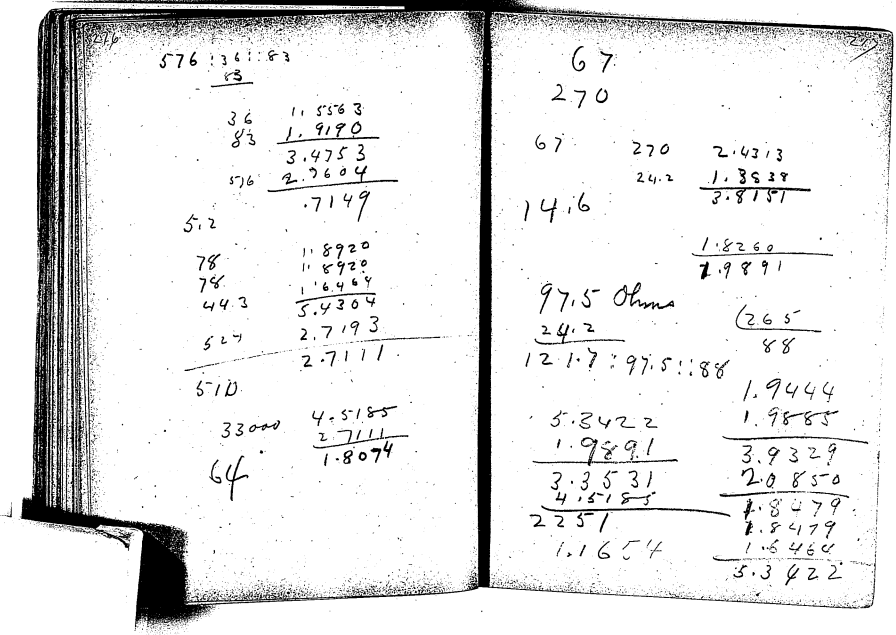
7.3
7
49

110.

151.

2 / 4950 . 2475
2475 12
4950
2475
0

2475
14
9900.
2475
34650



216

60 Ga | 28
4.66

28 · 18.2 · .6683 · 1.2600 · 1.9283

84.8 Ohms

18.2 · 724

1030 : 84.8 :: 88 : 724

1.9283
1.9444
3.8727
2.0128
1.8599 12.
1.8599
1.6464
5.1662
1.9283
3.4379
4.5185
1.0806

192
2
384 Ohms hot

10

192 Ohms 2 lamps
19.2 Ohms in line
211.2 Ohms

3 | 260
86.6

Again
195

211.2 : 19.2 :: 86.6 : 78
76.8

1.9375
1.2833
3.2208
2.3246
.8962 .7.8

1.8853
1.8853
.6464
5.4170
2.3246
3.0924
4.5185
1.4261

2 | 1240 ft. lbs
620

26.5
2
53 per H.P.

F.R.W.

195 ohms

390 (2)

195

25

220 : 2.5 k : 86.6

1.9375

1.3979

3.3354

2.3424

.9930

86.6

9.8

76.6

1.8842

1.8842

2.1.6464

5.4148

195 2.3424

3.0724

4.5165

1.4441

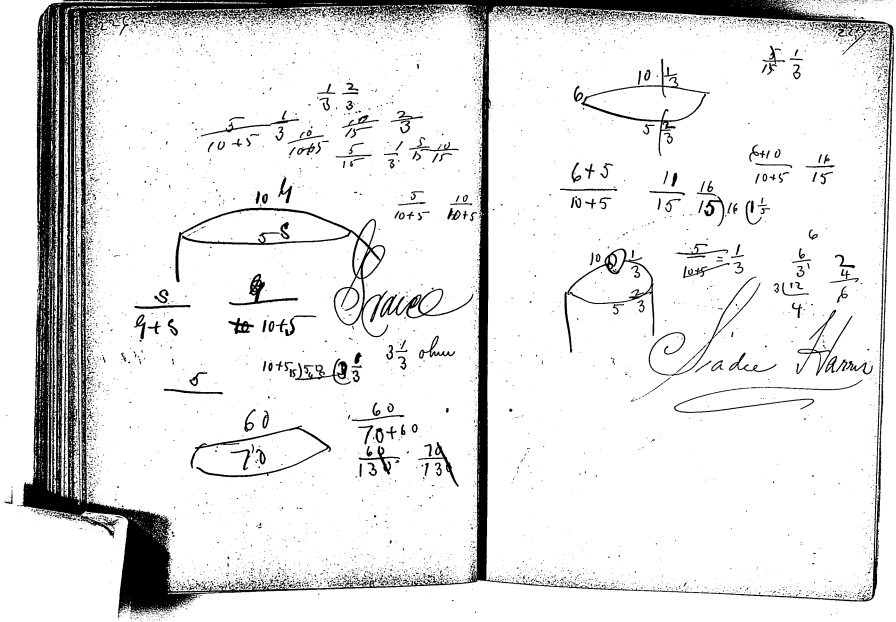
1180

590

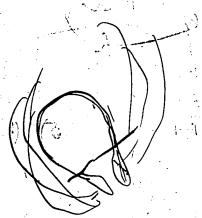
27.9 (2)

55.8

for H.P.


Grace
Sadie Harris

228



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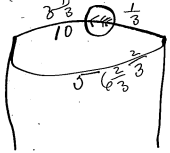
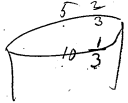
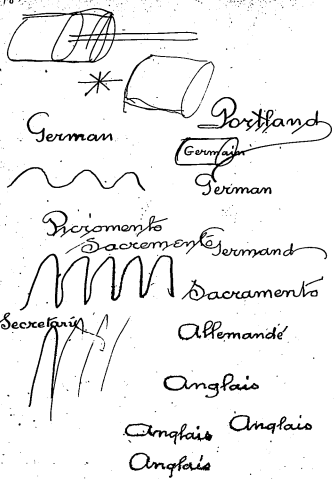





Portland
Germain
Germain
Germain
Sacramento
Sacramento
Sacramento
Allemand
Anglais
Anglais
Anglais
Anglais

500,000

25,

8 - cubic $\frac{1}{16}$.

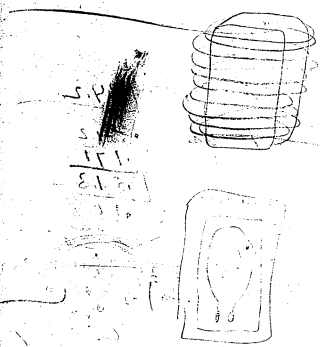
$\frac{1}{25}$ of a part of an inch, $1\frac{1}{2}$ inch,

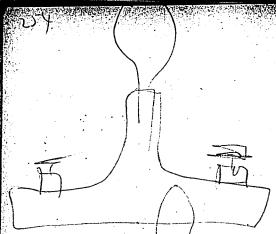
16
16
96
16
256
16
3-36
256
4096

8
800
8
6400

1½ inch an atmosphere pressure

½ inch by $\frac{1}{16}$ diameter





1000 | 34.2

1 cu foot . 342

.171

7000 grains one lb .513

.103

.1

2480 grains = 29 Grammes

440) 29000 (6

0

7000 grains in

15 grains to Gramme

1000 mg

15) 1000 (66.6

70

100

.0876 Grammes

1

6.66

6.6 mg

16 : 7

7/16 X 6.6

7

16) 462 (28

32

142

124

29

140

122
122
244

244
122
14884
44

5953 6
5953 6
5953 6
604896

265 / 604896 (22
530
748
795
530
265 / 801900 (32
795
6690

137
137
959
411
13769
187

18769
44
75076
75076
8258836

141
141
141
564
19881
44
79524
79524

265 / 8258836 (31
795
308

Portland
144
144
576
576
144
20736
44
82944
82944

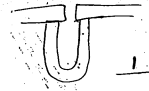
265 / 8747647 (3309
795
797
795
264

Portland
3300

265 / 9123884 (33
795
1173
795
378

30 3300

265
265
1060
1060
1325
1325
100



1

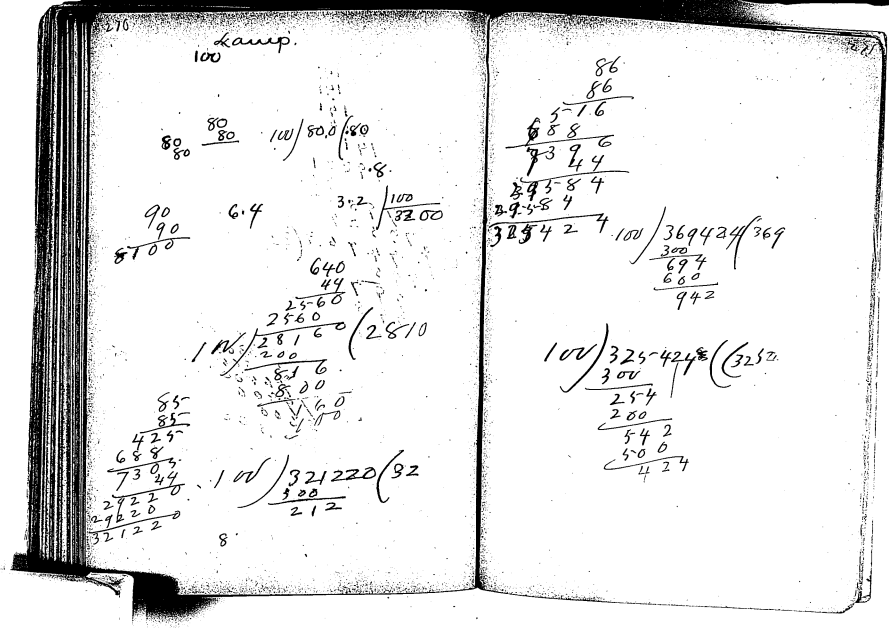
For Portland

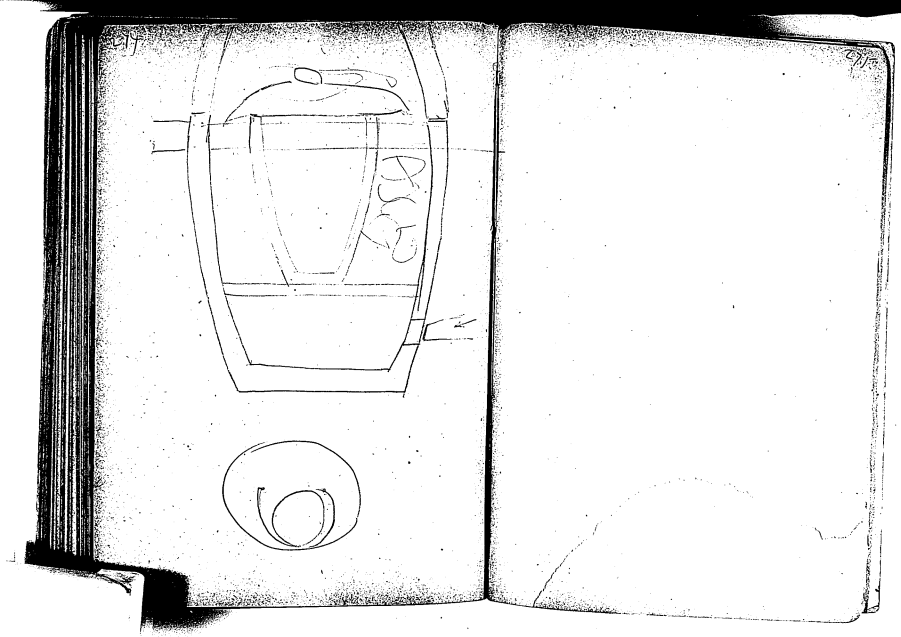
E $H_2O_1 \times Ca_2NaO$

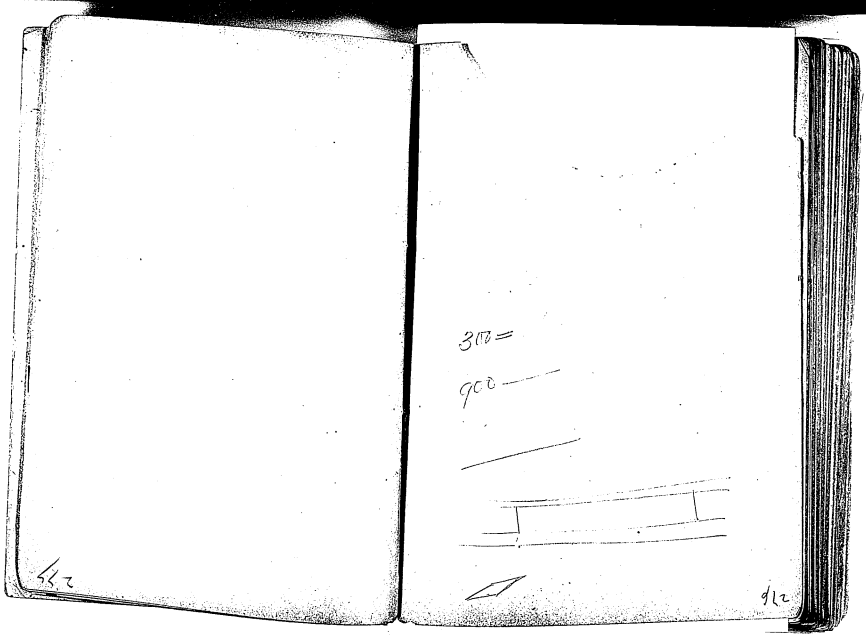
141
141
141
5-64
141
19881
44
795524
795-24
2.65 | 87477 (3300.
795-
797
795-
274

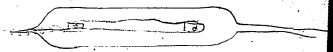
3300
265
16500
19800
26400
874.500

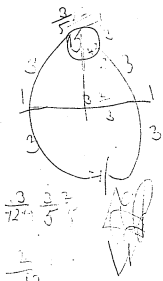
Lamp.

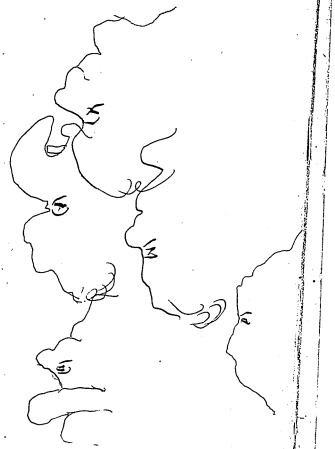


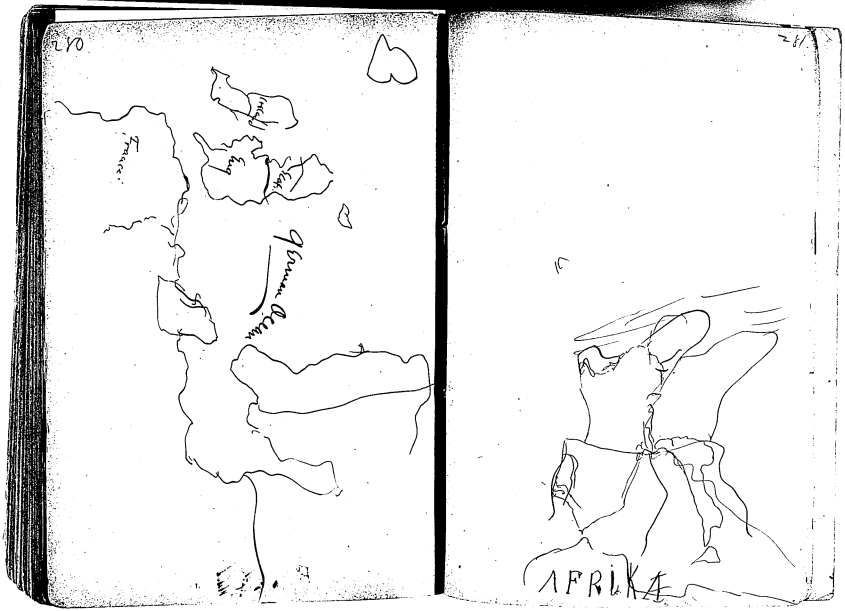


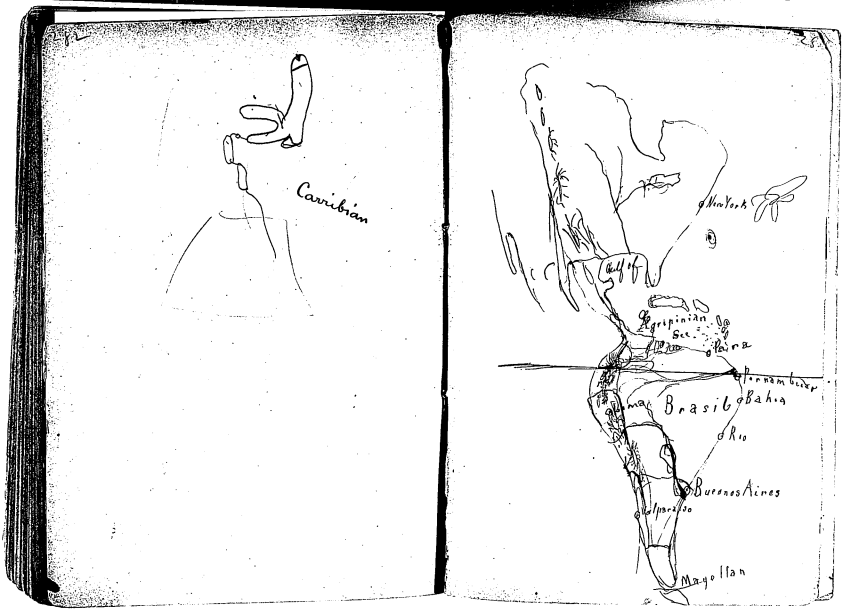

300=
900

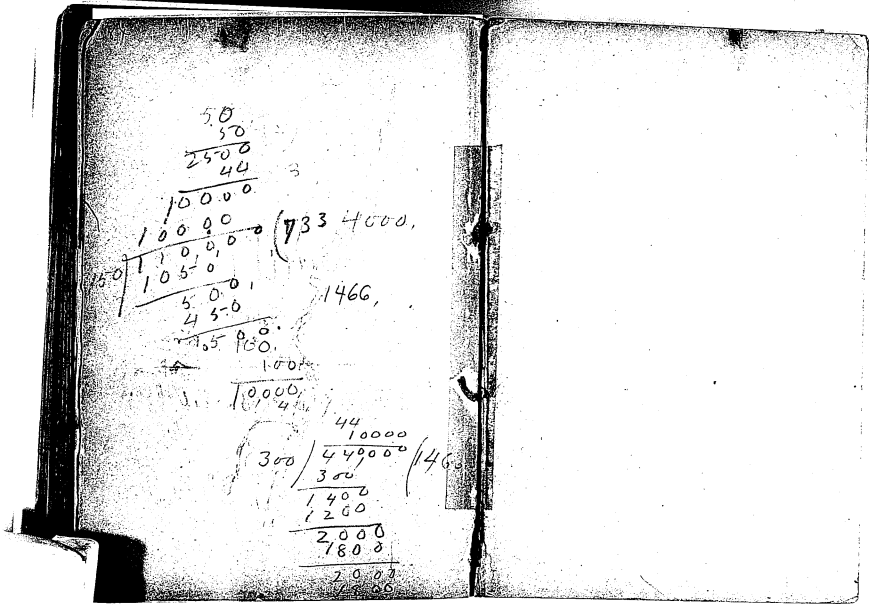







Nil
AFRIKA


Carribian
Gulf of
Mexico
New York
Pernambuco
Brasil
Bahia
Rio
Buenos Aires
Valparaiso
Magellan

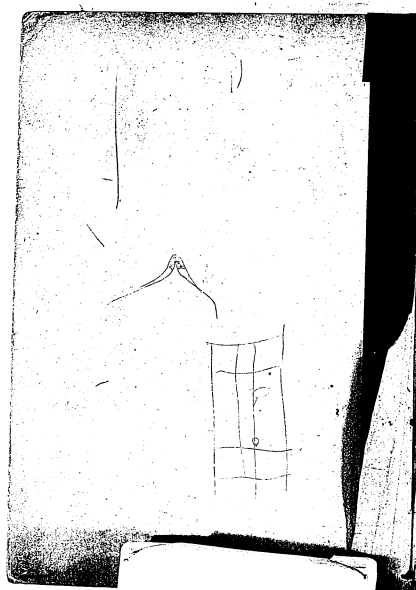

50
50
2500
44
100000
100000
10000
1733 4000
150
1466
44 10000
300
44000
1400
1200
2000
1800
200

Menlo Park Notebook #30 [N-79-04-08.2]

This notebook covers the period April 1879-March 1880. The entries are by Edison, Charles Batchelor, Francis Upton, Ludwig Boehm, Francis Jehl, and John W. Lawson. Most of the book consists of drawings of lamps and vacuum pumps. Earlier entries include notes on metal and alloy tests; notes on telephone experiments; and notes and drawings by Edison on generators and conductors. On page 195 is a drawing by Upton, depicting the incandescent lamp as "the phoenix arising from the fires of the past." The book contains 236 numbered pages followed by 4 unnumbered pages.

Blank pages not filmed: 178-179, 196-197, 204-221, 224-231.

Missing page numbers: 1-2, 95-96, 121-122, 141-142, 147-152, 155-156, 183-188.



1030

April 8 1904

1 Call complaint on line

We find this morning that it is low probably due to loss of water. 9 Edison can hear Marconi reading 3 feet away but do not understand what is said yet can hear "Mary" sir plain, with induction coil in circuit it reduces it ½ in volume.

Zinc & in C.K. I hear nothing Batch hears something 10 yards off.

Silver nearly as good as platinum finish Coil out, but ½ as good with

Apl 8 1879

Ruthinium not so good as platinium
Calling Platinum 100. then Ru 65.

Bismuth C.P. — When 1st put on it is not so good as platina but after burning ½ a minute it gets harder & harder until it equals or nearly equals platinium we now put on Pt and find Bismuth is harder, the Mallet does not squeak while Pt does Bismuth is worn a little,

Cadmium, Bate's does not have a mortal sound

Chas Batchelor

Apl 8 1879

Cobalt, about same as platinum perhaps better than Pt with the coil in, squeaks less than Pt. not worn -

Arsenic about 80 to Pt 100 - squeaks a little

Antimony, about same as Pt - perhaps slightly less volume. Squeaks about like Pt.

Tellurium about 50 to Pt 100.

Aluminium about 20 to Pt 100 Squeaks fearfully.

Edward Hutchinson

Apl 8 1879

Thallium - Batch hears nothing

Iridium - about same as platina

Nickel 65 to Pt 100, Squeaks badly

Iron - Chem Pure. 55 to Pt 100

Chromium. Nothing at all.

Platinum Iridium alloy
Notes - good as platinum
Wrought-iron [illegible]
ascertain and find that it is
as good as Platinum

April 1. 1919

The Chalk is getting dry and uneven surface Platinum comes quite low so I can just hear him read but not to understand when the Cord is out -

Sulphide of Lead about 40 pc to Pt 100 -

Brass, about same as platina

Babbitt Metal Exceedingly low Batch just hears it, it appears to be as hard with cord in as out

Chas Butchart

12

Apl 8 1899

It got so dry, that we had to wet it
then Pt came out loud,

Magnesium - Batch means absolutely
nothing - current passes through
ok -

Gold - about 55 to Pt 100

German Di Puer works easier even
~~Dutch~~ with stringer pressure
about 75 to Pt 100

Di Sulphide Tin (magnesium) Very low,
Very Very very low low,

Charles Batchelder

14

Platinum

Apl 8 1919

We find German Silver to be slightly louder than Platinum on dryer chalk and a little louder on wetter chalk

Tin, low- very few I dont hear it 3 feet away

Note we find it very difficult to make comparable tests owing to drying of Chalk & from the [illegible], We now have put in Tin again but find it exactly [illegible]

Sincerely
Chas Batchelor

April 8 1899

Lead – Batch can scarcely hear it.

Copper – not so good as Platina.

Sulphide Copper
Phenomenal
– loud as Plat.
Try again

Carbon – [illegible]

Charpentier

Apl 8 1899

Will try without any battery on. no constant -

Platinum not so bright as with battery -

Zinc, about 60 to Pt-100

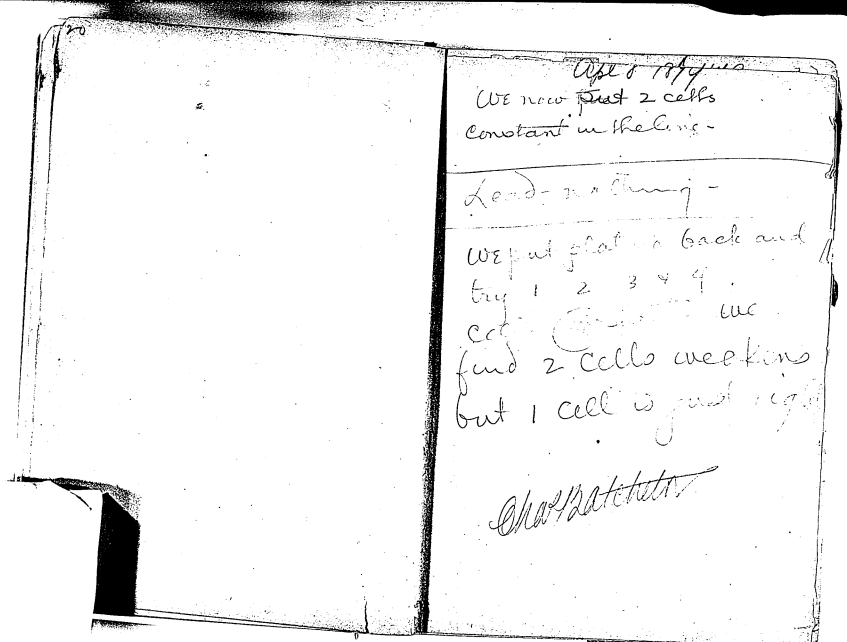
Tin - Low - about 20 to Pt 100

German Silver - about same as Platina -

Lead - Nothing

Charlotte

No need of further on this -



Apl 8th 1879 20

We now put in Chalk 2

3 oz Chalk
5 grs Acet Hg.
½ fluid oz Cinnam Aqua

Platina [illegible] -

With 2 cells [illegible] in primary and 1 cell in Aux permanently talking ~~not so~~ loud as on Nov 1878 to [illegible] I see no difference

The ordinary width of Chalk is best the ½ wide being the worst and there is apparently no difference between

April 8 1949

1/8 and 3/16 ~~Fiber~~

I turned off the roller perfectly smooth and started on the 5/8 but the result was the same

Think this button is equally as good as No 1 difference of 4 gm Mercury making no difference

Made No 3. button -

{ 30 gr Chalk
{ 1/2 fluid Na.C

With no Acet Hg but it is far inferior to 1+2. Low talking which no wetting will make as good as 1+2

Shot 3 Satisfactory

April 9 1879

We put in No 4 button

3 of Chalk
15 Grain Acet Hg
½ Fluidg Na O

This is very low indeed and not near so good as 1 & 2. Afterwards I wet it some but this did not improve it I tried German silver on this and it was just as good as Platinium We put this button by to dry out a little & try again

Made No 5 Button

3 of Chalk
25 grains Acet. Hg
½ Fluidg Na O

This is better than 4 but not good enough when wetted more it was worse

Chas Batchelor

Made No 6 Button —

{ 3 ℈ chalk
40 grams Acet. Hg
½ fluid ℈ Na O }

This gave nothing at first and made the magnets very weak by reason of being too dry I suppose, and putting too much resistance in the line — when wet it became a little better but is good for us as it is too soft + takes too much pressure with plenty of water + left to soak it up + came better but not quite as good as 1+2 Edison afterwards by continually spraying water afterwards brought this button as short he thought it equally as good as 1+2

No 7. Now putin No 7 - - - -

3ß Chalk
100 grs Acet Hg
3 fluid ß Na. O.

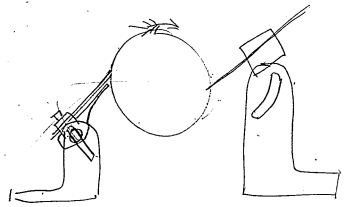
When we put this in at first it talked well but after wetting considerable it did appear so good. the excess of Hg seems to alter color of this to yellow

No 8.

3 ß Chalk
9 grs Acet Hg
3/4 fluid ß Na O

32

33



Experiments with the standard
Cymometer Machine - & new Cymometer
July 5 1879 - T A Edison -

Wright 929.-

I find that if you run the
sliding weight
point when the beam is
permanently down
a point nearer
common centre up the
weight will be the means of
placing the centre of the
I found it invariably balances
nearer that point than any
other,

2 - 50

42

21
4
29

3 & 28 1/2

229.
3
145

1-22 5

4 3/4 1/2

41

24

9 1/2

- 2 1/2

5.

6

125

43

1170
2
2 3 4 5
29 42
30 71

4 3/4
10

24,

2 1/2

26 1/2

28 3/4

256 - 2 1/2 lbs.

1 1/4.

30.

31 1/2 .1

15 3/4

weight 929 =

Speed 229 distribution with proxy

deflection with proxy on ~~3-1~~

924 - lbs of 929 weight 1 lb 4 1/2 oz on Lever, 20 inches out. Speed 2.5 main shaft. 188,

Result

Ours - 3088 ft lbs

Proxy 3070.

Another test.

Weight. 3 lbs scant - 20 inches out,

Original weight 929. - diff 13 1/4 lbs.

Speed 236

Result.

Ours 7990 -

Proxy 7102.

38

29 5 28 33

895 - 1/2 33

3 1/2

29 1/2 4.15

7162 (366:0 / 5:8:10) 5
7.2.46.0

31 1/2 33

94 1/2 16 1/2

16 1/2 7162 (36650 / 51810) 5
87.0.

29

16 1/2 15

13 3 13.9.

15

14 lbs 10 1/2 ozs

35

Undertake it again -

Difference - 12 1/2 lbs -

speed 238,

Result,

Ours 7540,

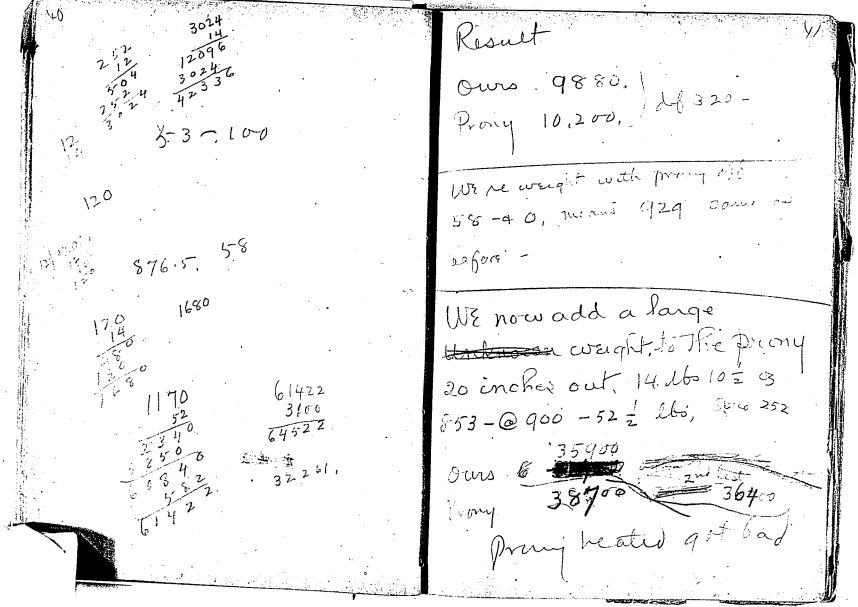
Proxy. 7162

We now add 1 lb & 1 oz more to the 3 lbs scant. on proxy -

Speed 240 - (895 - 1/2 929.

another 894 1/2 931 1/2) mean

912.62 - Lift 16.38,


Result
Ours 9880.
Proxy 10,200.
Δ 320 -
We weight with proxy 1/10
58 - 40, mean 429 ours
22 for -
We now add a large
20 inches out. 14 lbs 10½ oz
853 - @ 900 - 52½ lbs,
Ours
Proxy
Proxy heated a bit bad

46 - 95 1/2

1111 47

47 1/2 47 1/2 47 1/2

111 ÷

29 3 1/2

25

29

57 1/2

900 940 - 920

889 954 - 921 1/2

88 57 1/2 954 918.2

57 1/2

Over

1170

57 1/2

8190

5850

6669

5-8

6727

30

7027

35.135

100

888
956

11

-13

~~956~~

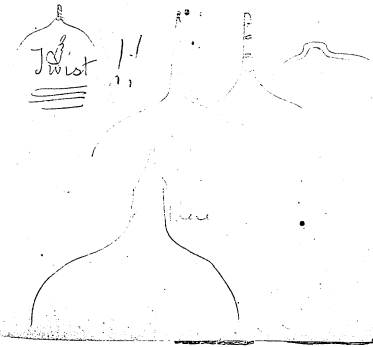
59

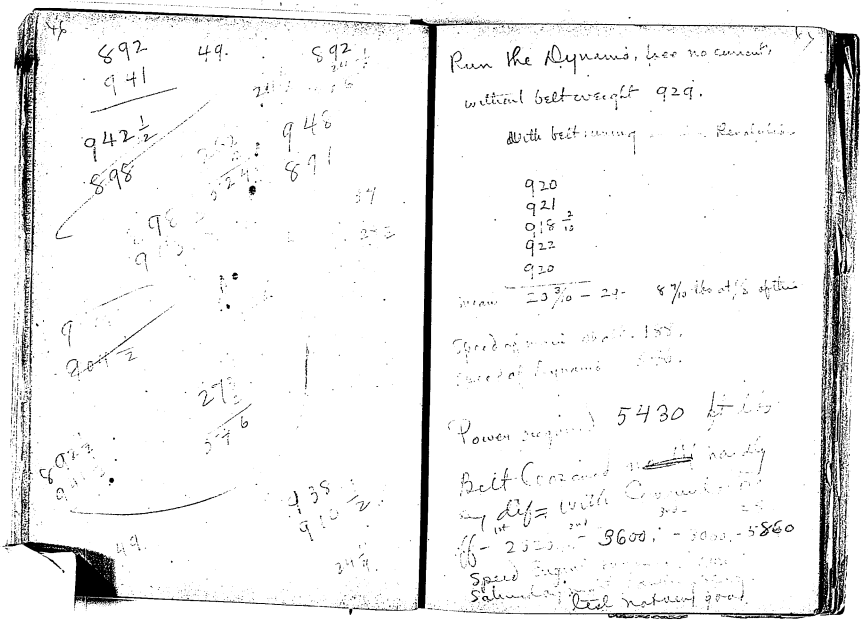
950
891

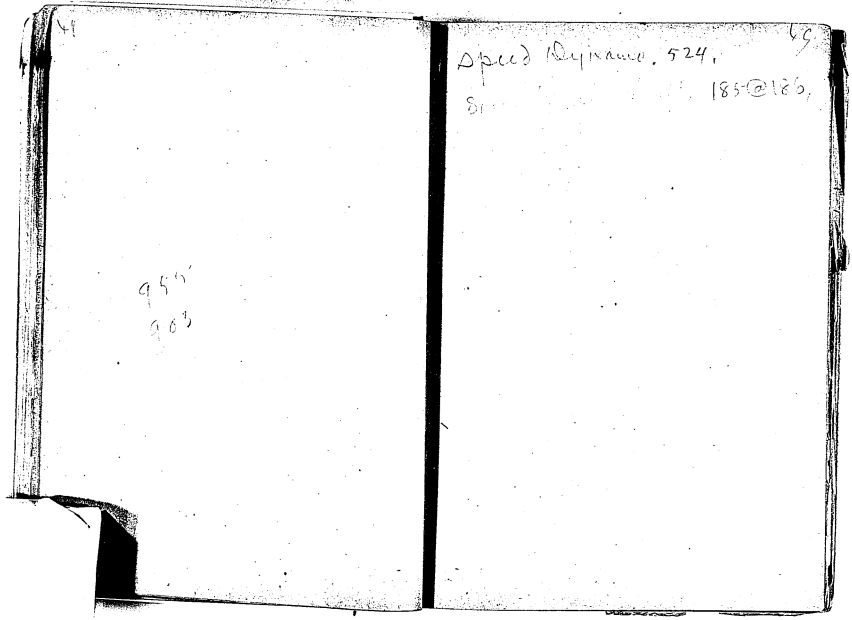
1170
49
1855 0
585 0
690 30
340 3
72 43 0.

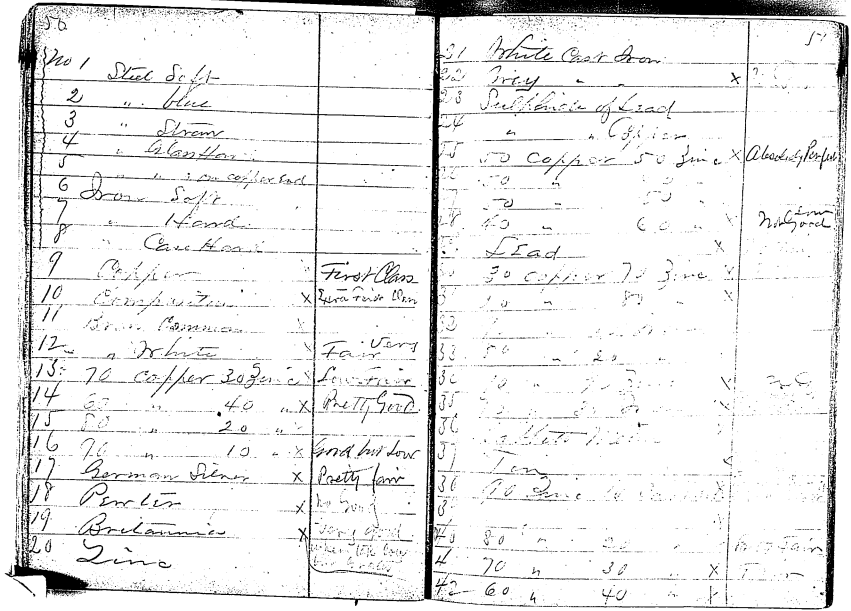
36215

920
921
918 2/13
922
920 2/2






Dried Quinine. 524.
185@186,
95°
90°



43	50 Zinc	50 Copper	X	NG
44	40	60	X	Fair
45	30	70	X	Fair
46	20	80	X	Fair
47	10	90	X	Pretty Good
48	Sulphide Zinc		X	NG
49	Mainly Metal 40% Cu			
50	10 Copper 90 Zinc			
51	80 " 20 Iron		X	Poor
52	30 " 70 Lead		X	Fair
53	" 10 "		X	Pretty Good
54	80 " 20 "		X	Very Poor
55	70 " 30 "		X	Fair
56	60 " 40 "		X	Fair
57	50 " 50 "		X	Just Ruling
58	40 " 60 "		X	Just rated Try 4.05
59	66 2/3 " 33 1/3 "		X	Fair
60	Metal 69 cm sl. Flux		X	Fair
61	Sulphide Iron			
62	60 Copper 40 antimony		X	Fair
63	50 " 50 "		X	

53

10 Copper 90 Columbium		X	
40 " 60 Antimony		X	Fair
30 " 70 "		X	NG
20 " 80 "		X	
70 " 30 "			
80 " 20 "			
90 " 10 "		X	Fair
10 " 90 Lead		X	Fair
20 " 80 "		X	
20 " 80 "		X	
60 " 40 Iron		X	
80 " 20 "			Fair
30 " 70 "			Fair
20 " 80 "		X	
10 " 90 "			Fair
1/2 Zinc 10 Antimony		X	
80 " 20 "			Fair
70 " 30 "		X	Fair
60 " 40 "		X	Fair Gas
50 " 50 "			NG

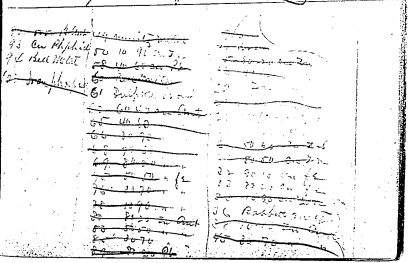
43	50	Zinc 50 Copper	X	NG
44	40	60	X	Fair
45	30	70	X	Fresh Cut
46	20	80	X	Fair
47	10	90	X	Pretty Good
48	Sulphide Zinc		X	NG
49	Mainly Metal	40 Zinc 60 Cu		
50	10 Copper 90 Zinc			
51	80 "	20 Iron	X	Poor
52	30 "	70 Zinc	X	Fair
53	"	10 "	X	Pretty Good
54	80 "	20 "	X	Very Poor
55	70 "	80 "		
56	60 "	40 "	X	
57	50 "	50 "	X	Pretty Fresh Rock
58	40	60 "		Tr $4.05
59	66 2/3 "	33 1/3 "	X	
60	Coal Mine	69 and 31 Flux	X	Fair
61	Sulphide Iron			
62	60 Copper	40 antimony	X	Fair
63	50 "	50 "	X	

64	10 Copper	90 Calcium	X	
65	40 "	60 Antimony	X	Fair
66	30 "	70 "	X	NG
67	20 "	80 "	X	
68	70 "	30 "		
69	80 "	20 "		
70	90 "	10 "	X	Fresh Rock
71	10 "	90 Lead	X	Fair
72	20 "	80 "	X	
73	30 "	70 "	X	
74	50 "	40 Iron	X	
75	50 "	50 "		Fair
76	30 "	70 "		Fair
77	20 "	80 "	X	
78	10 "	90 "		Fair
79	Zinc 10	Antimony	X	
80	80 "	20 "		Fair
81	70 "	30 "	X	Fair
82	60 "	40 "	X	Fresh Rock
83	50 "	50 "		NG

53

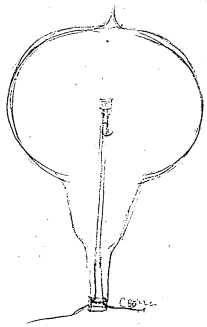
84	40 Tin 60 Antimony	X	Poor Good
85	30 " 70 "	X	Poor
86	10 " 90 "	X	Good
87	20 " 80 "	X	No test
88	90 Lead 10 "	X	Part T
89	80 " 20 "	X	
90	70 " 30 "	X	
91	60 " 40 "	X	
92	50 " 50 "	X	
93	Iron Phosphide		
94	Rose Metal 78 Bi 22 Tin		
95	Mineity Metal 56 Cu 43 1/2 Zn 3 1/4 Pb	X	Pretty good
96	10 Lead 90 Antimony	X	
97	20 " 80 "	X	Poor
98	30 " 70 "	X	Pretty Poor
99	40 " 60 "	X	Antimony
100	Rose Metal 40 Pb 60 Tin 100 Bi	X	MS
101	Lead Phosphide	X	
102	Tin Phosphide - Good many Lumps	X	

103	Iron Phosphide		
104	Copper & Tin Sulphides Equal	X	Poor Poor
105	Nickel Sulphide	X	Poor
106	50 Lead 50 Cadmium	X	MS
107	50 " 50 "	X	MS
108	10 Lead 90 Cadmium	X	MS
109	60 " 40 "	X	Good
110	80 " 20 "	X	
111	40 " 60 "	X	MS
112	" " "	X	MS
113	Phosphide of Antimony	X	MS

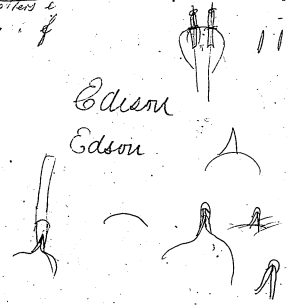


114	Pure Silica
115	Eglinus
116	Bismuthite
117	Cadmium
118	Tungsten
119	Cy. Hydrogen
120	Cyanide Barium
121	Carbonate of Soda
122	Barium
123	Phosphate of Lead
124	Carbonate Copper
125	[illegible]
126	[illegible]
127	Lead [illegible]
128	[illegible]
129	Nitrate [illegible]
130	[illegible]
131	Nickel
132	Lawrencium No 2
133	Zinc

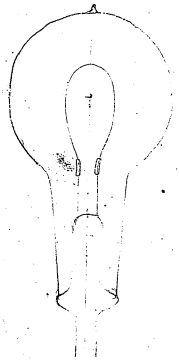
134	For Hydrate
135	[illegible]
136	Iridium
137	Selenium
138	Carbonate of
139	Cyanide of
140	Red Iron Ore
141	[illegible]
142	
143	
144	
145	
146	
147	
148	
149	
150	
151	
152	

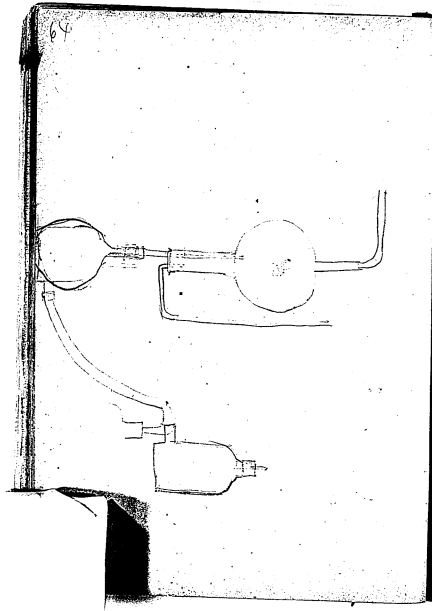


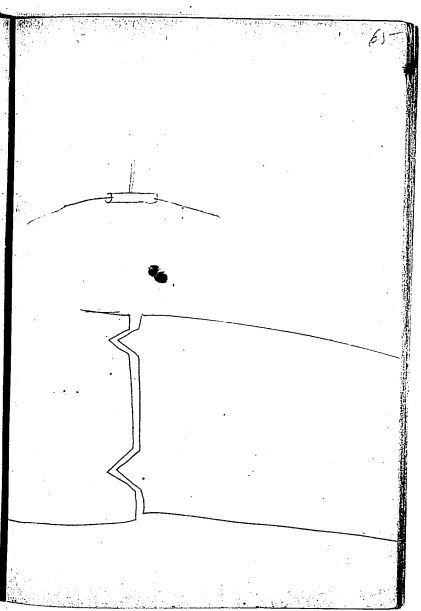
Letters b numbers 2 sewn medal 3
" d " 4
Tissue needles missing
Paper missing matter
Letters c " 5
" f



a No 50 Le Roy & Otis Tube (needles).
b " 51 Nos 53 & 54 Bottles given to Washington

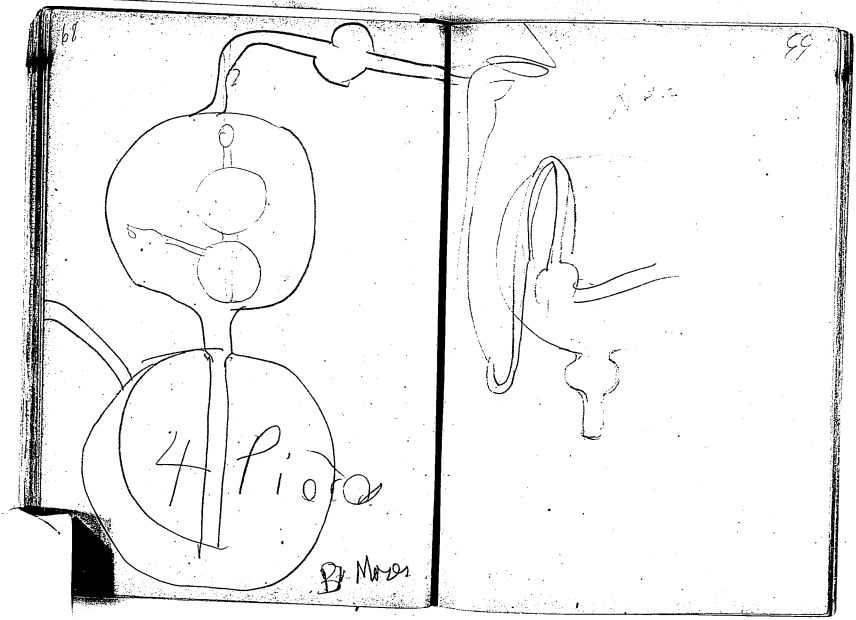


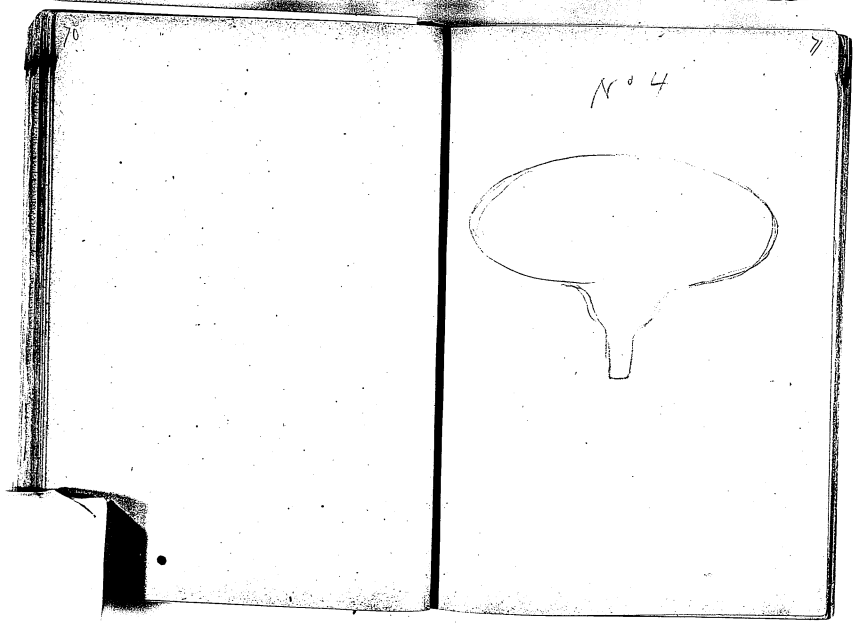




N° 1

N° 2


4 Pi o
B. Mayo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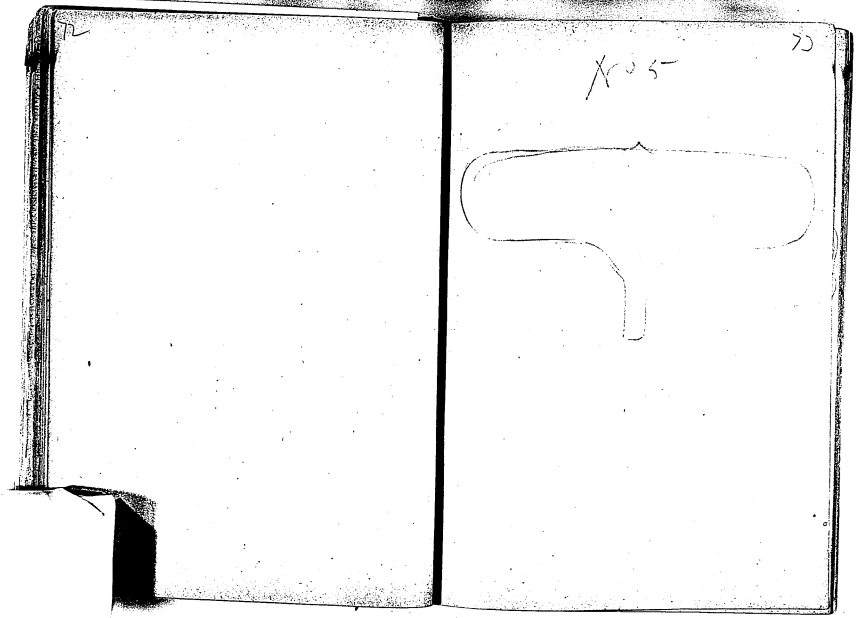
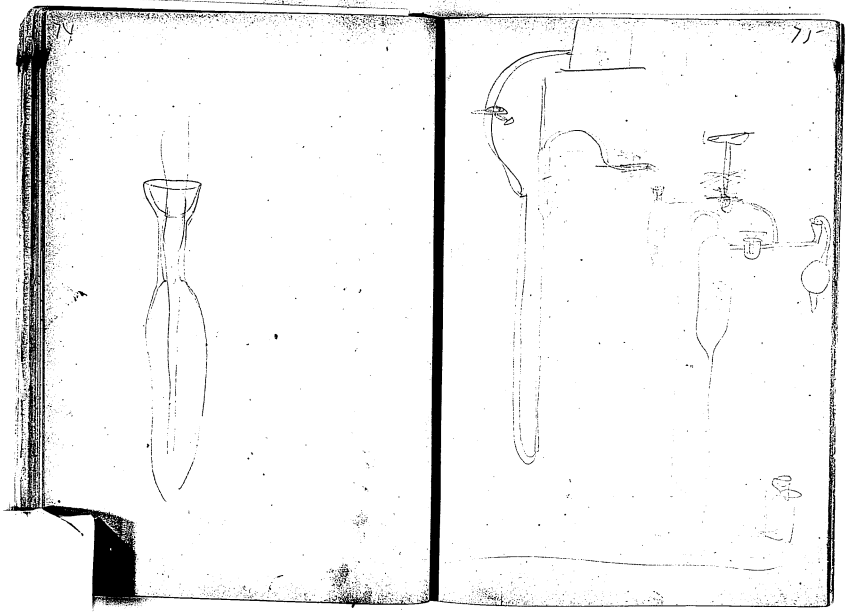
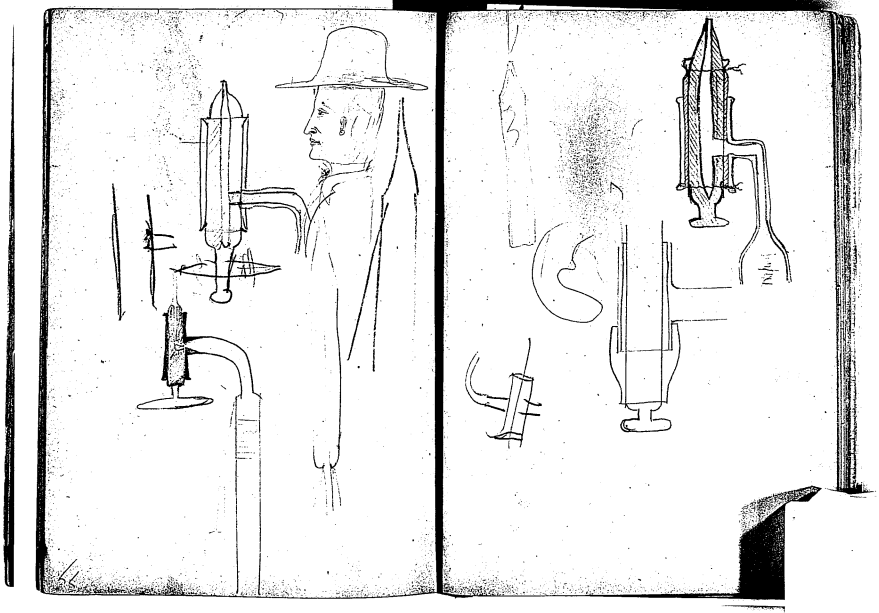
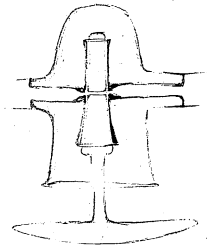
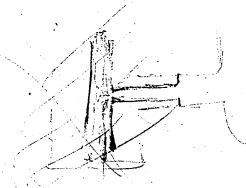
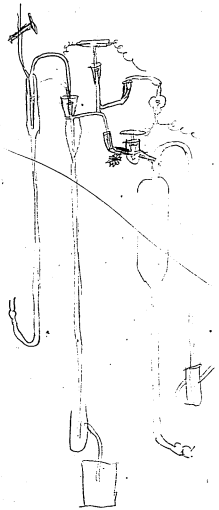




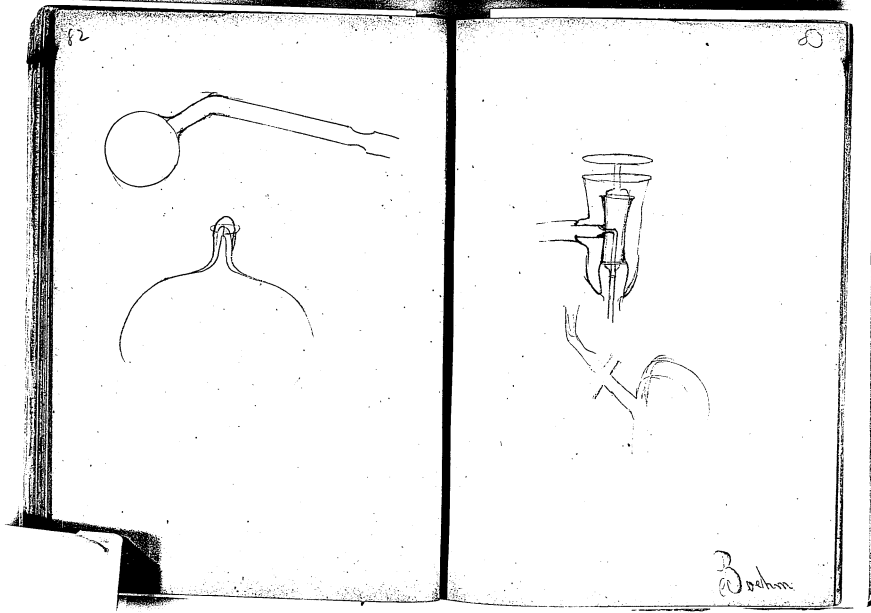


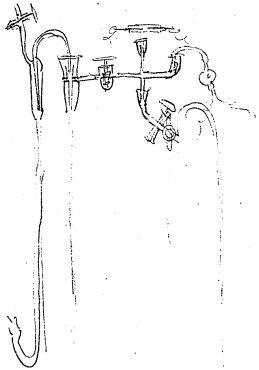


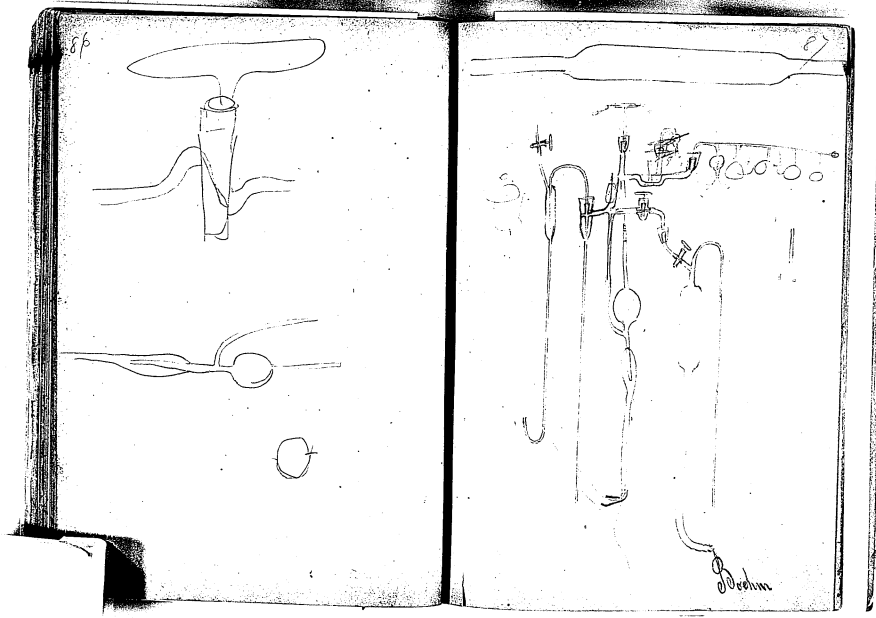




Beehm



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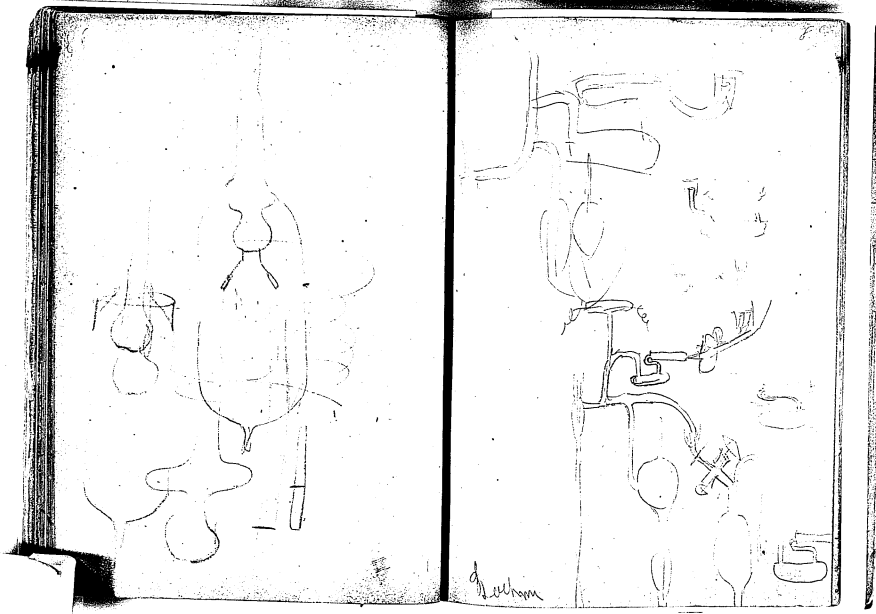

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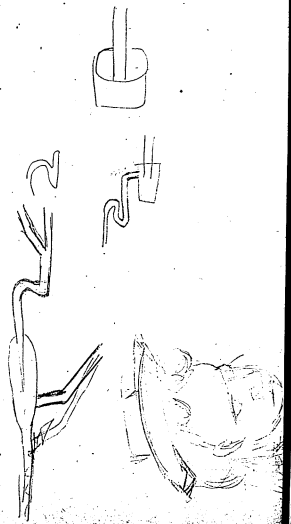

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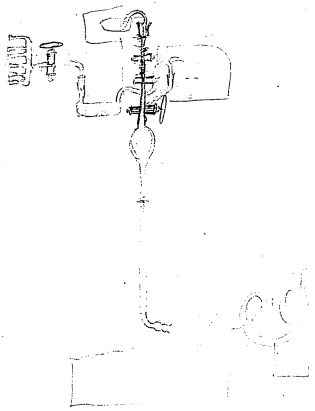
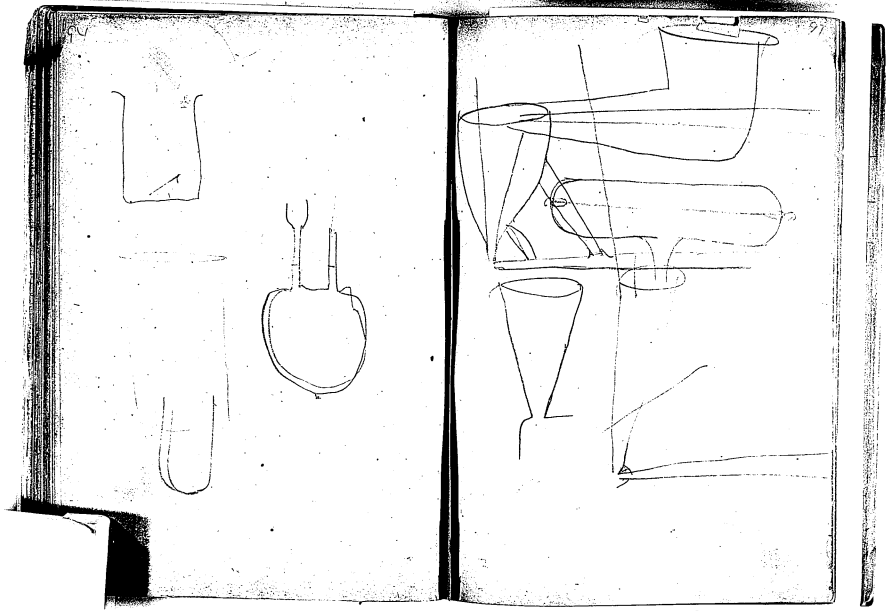
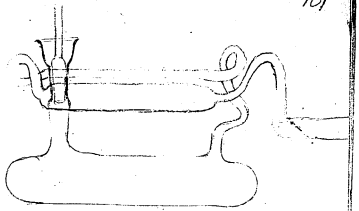
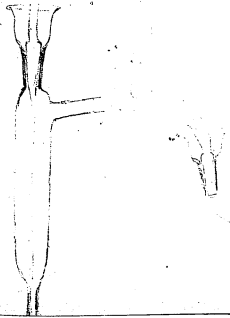
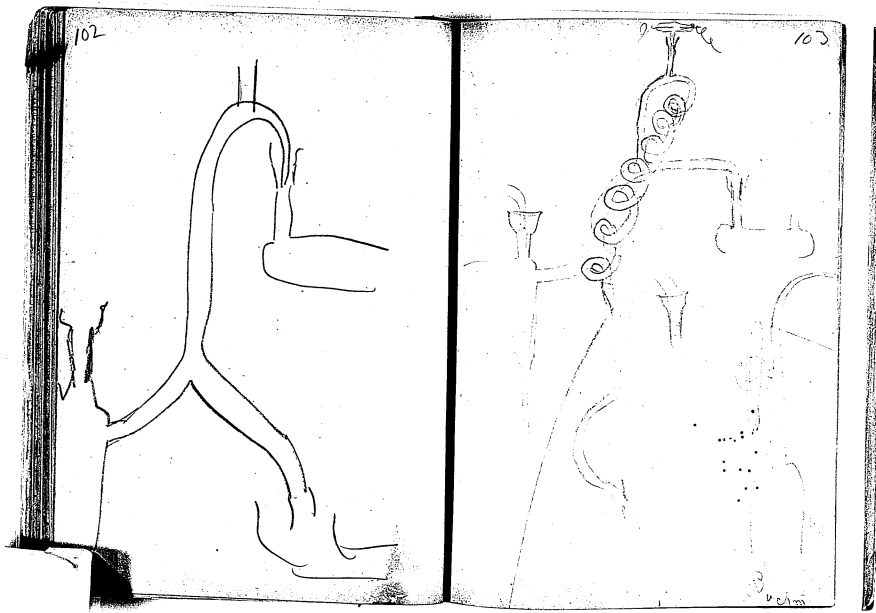


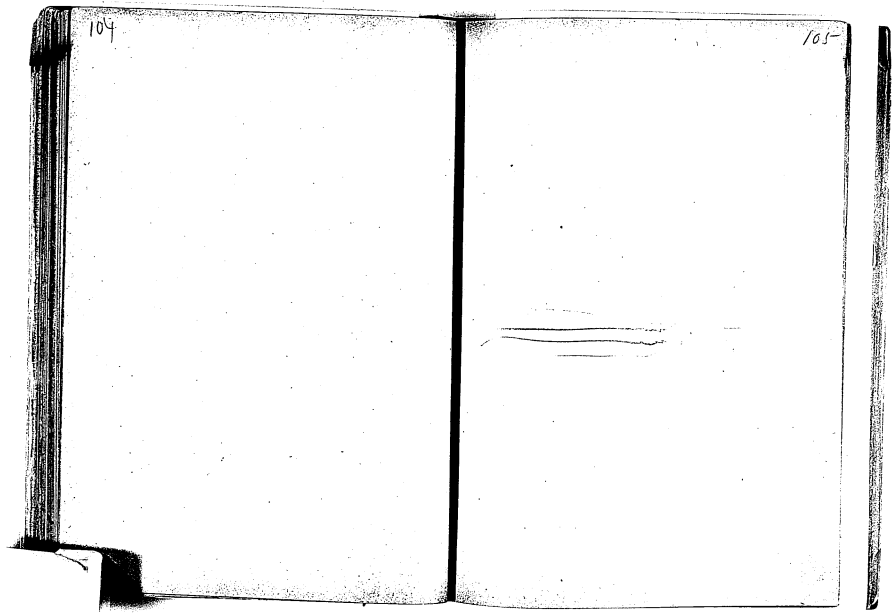
Feiffer pump








102
103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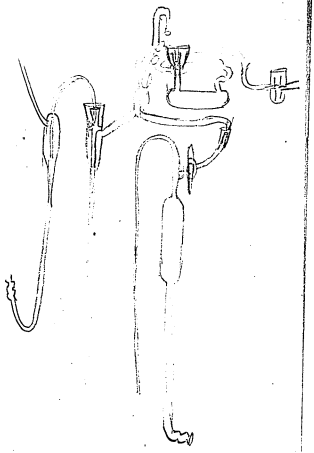
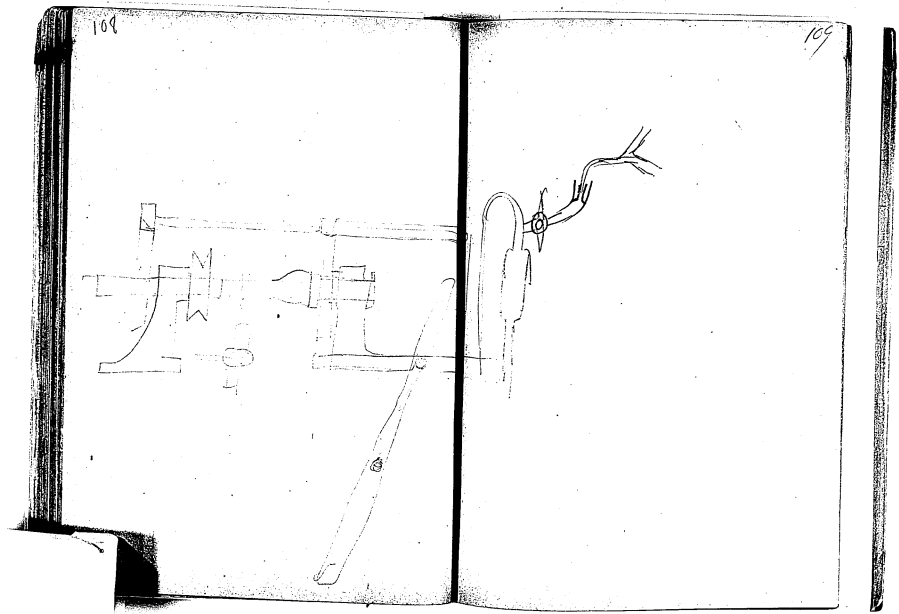
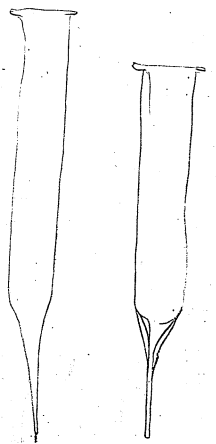
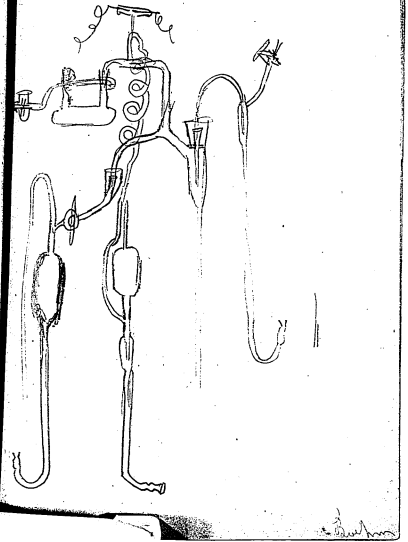
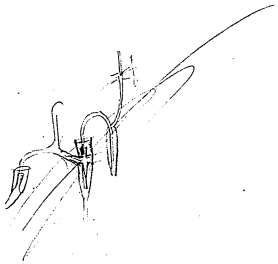
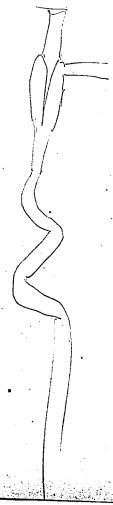










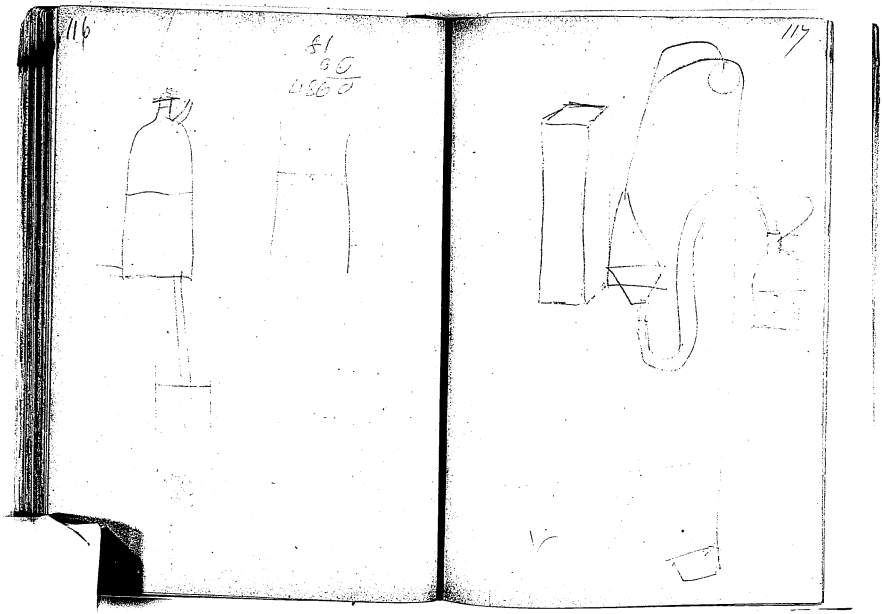


Art. bodyguard.

Scale long mm. 180.

Particolare di bandiera

Title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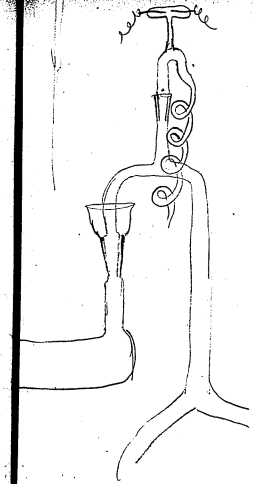
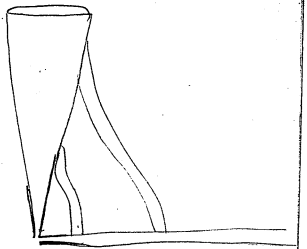
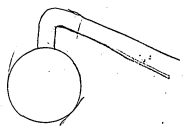
117







} celkem 6,112 mg. měřený 3,896 : 6 : 2,586 = 0,10828

1,188 mg

13,896 : 1,2586 = 0,1146

140,855

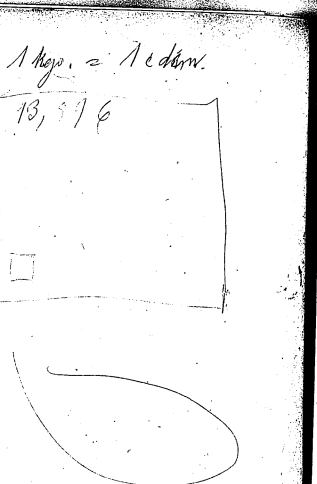
2813,896 : 6,112 = 460,2

13,396 : 23,14 = 1146,235

126

1 kgw. = 1 cdm.

13,596



127

0,090 mg

0,868 g

868 mg

3000,010 mg

60,044 mg

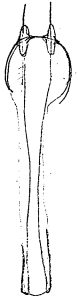
227,653 ??

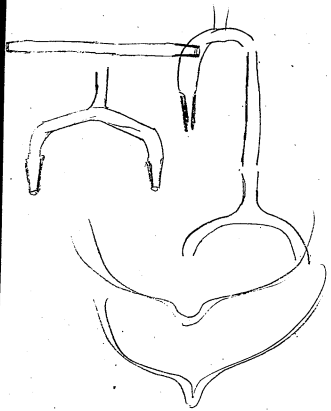
0,090
0,868
3000,010
3000,968

13,596 : 0,090880 = 0,00661
81576
84240
81526
366480
13596
13044

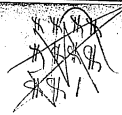
13,596 : 0,868 = 0,0638
81576
52340
49788
114520
108528
5992

13,596 : 3000,010 = 220,653
27192
28081
27192
88900
81576
73241
67980
52600
40428





L. H. Bochm



1114
146
1894

85,488
6,628
78,860

0,146 gr. : 13.596 : 0,1460 = 0,010741

13596
11[illegible]
108468
[illegible]

1,694 gr. : 13.596 : 1,8940 = 0,13921

13596
43440
40788
[illegible]
34102
[illegible]

233,808 cubic cm.

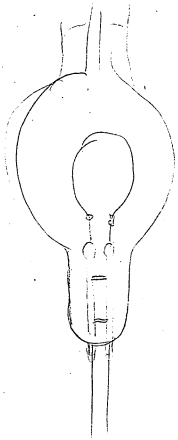
3168,855 gr.

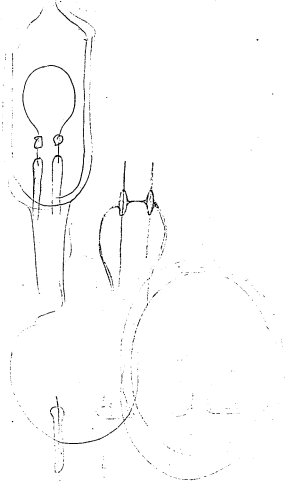
13.596 : 3.168.855 = 233,80881

24192
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

233,8081 - 439.65
0,1321 - 40788
0,0128 - 51.465
Total 233,9510 c. - 40728
10980
108468
[illegible]
108668
143 20

Pump № 3





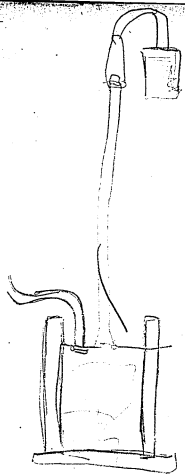
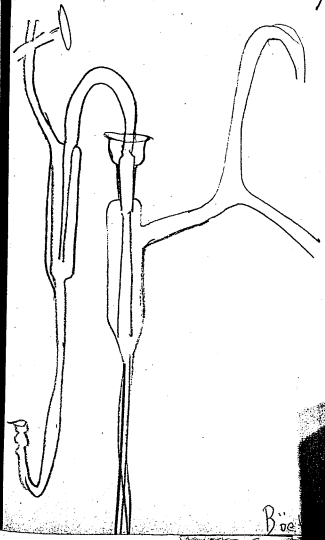
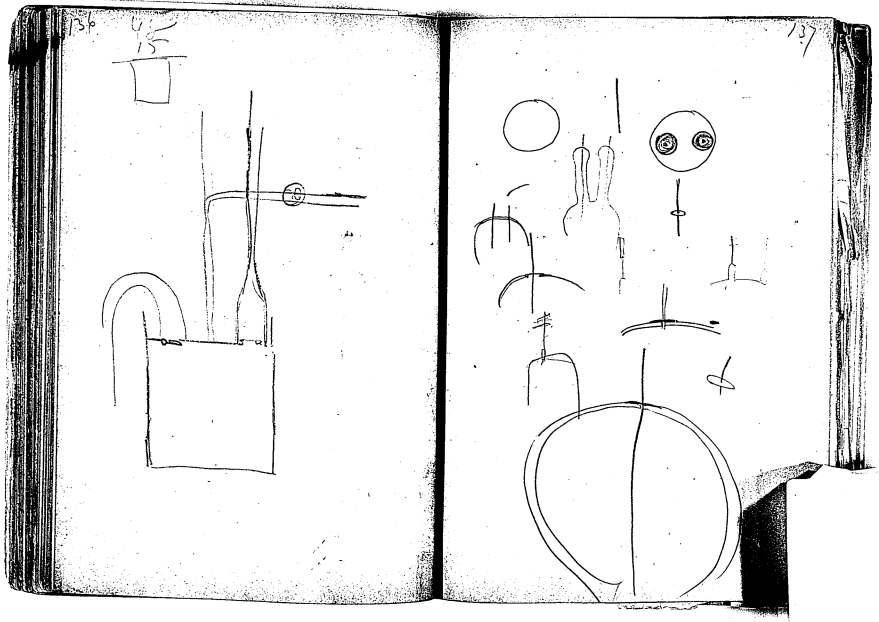
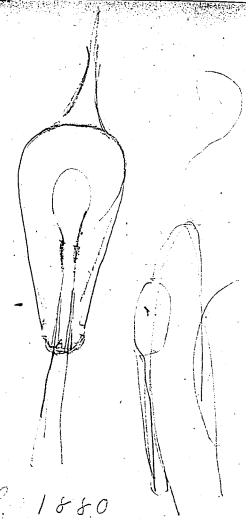


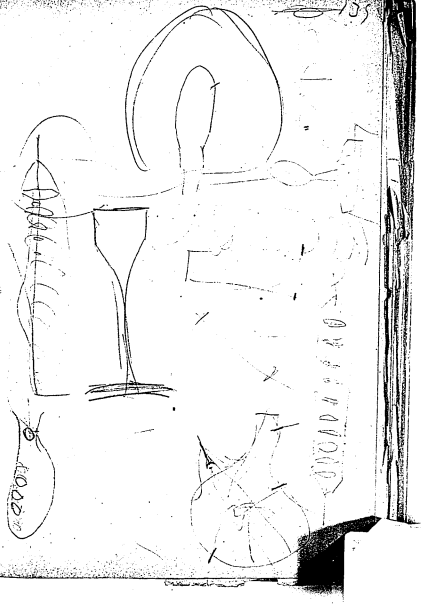
Fig. 1–2

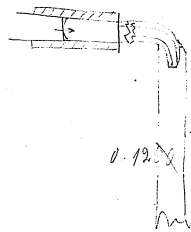



136
45
15
137



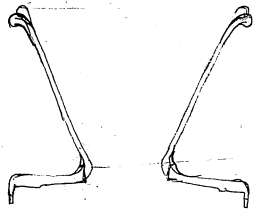
J. S. 1880

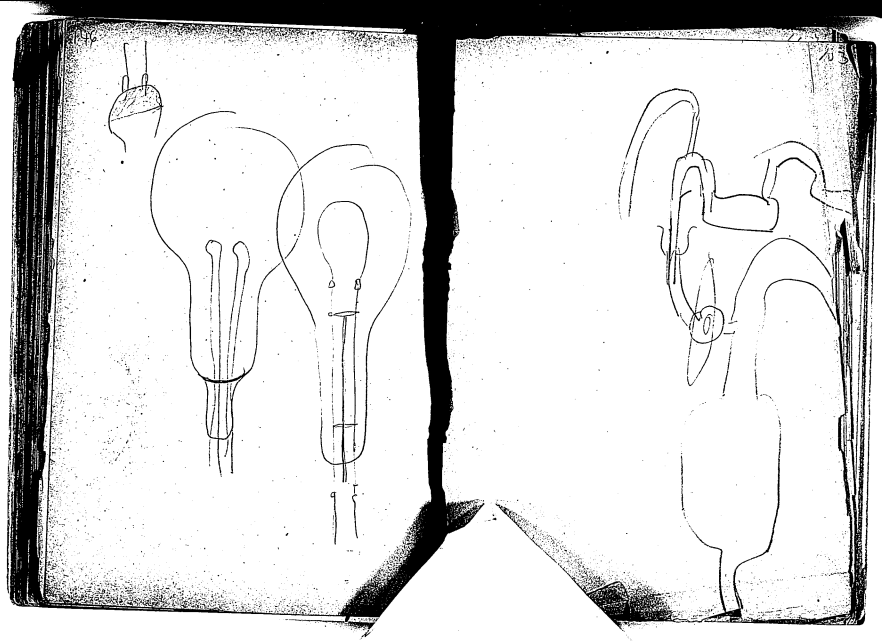


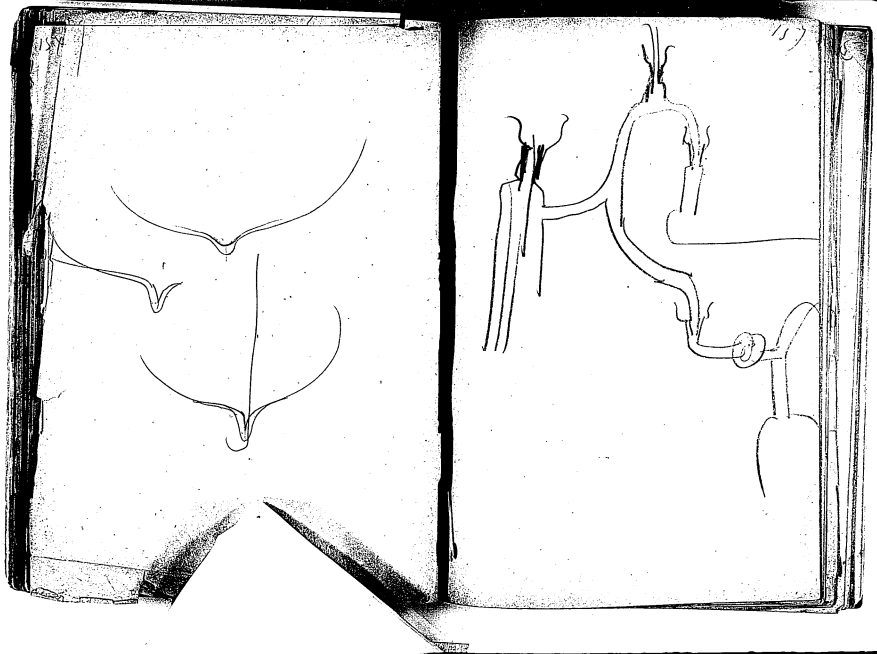


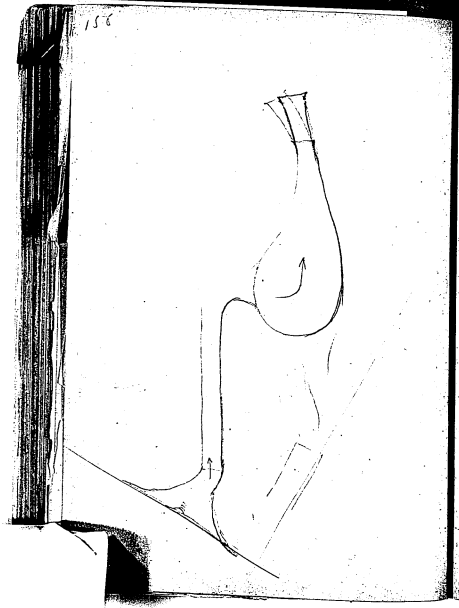
$\frac{3.20}{152,000} = \frac{1}{50,500}$

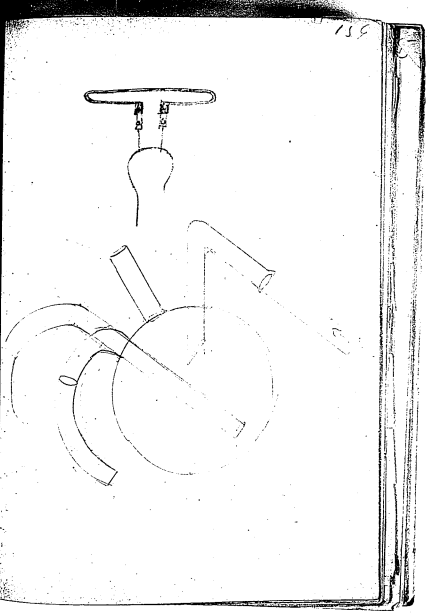
y = atmospheric pressure in lamps.

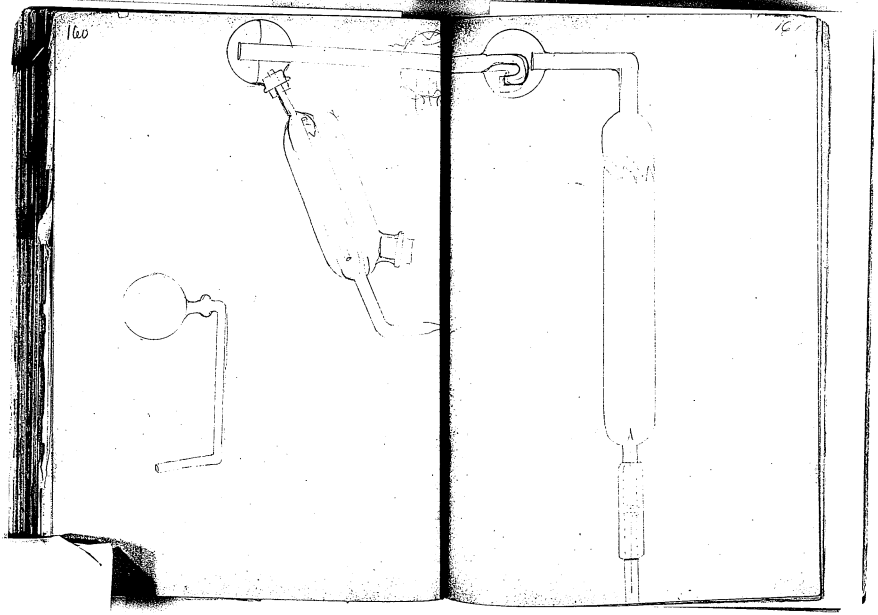


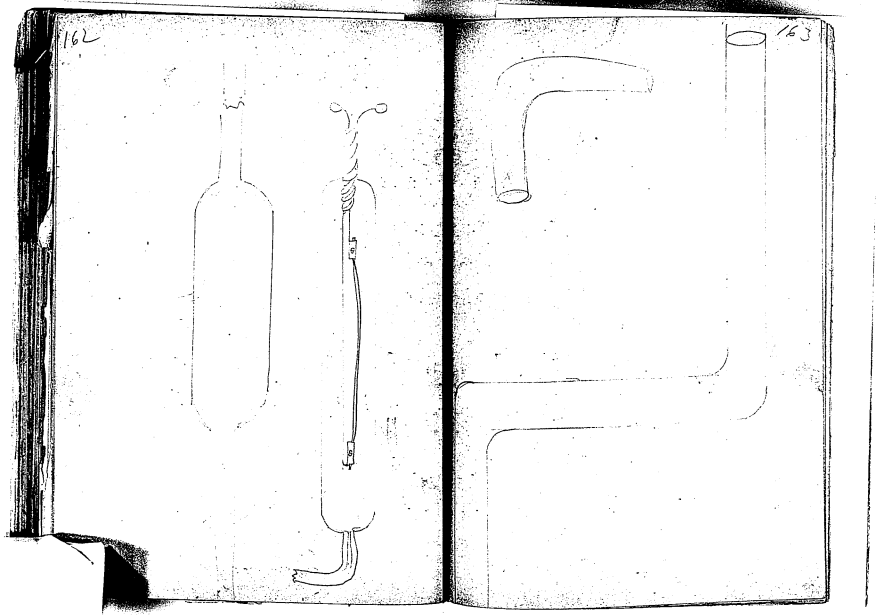


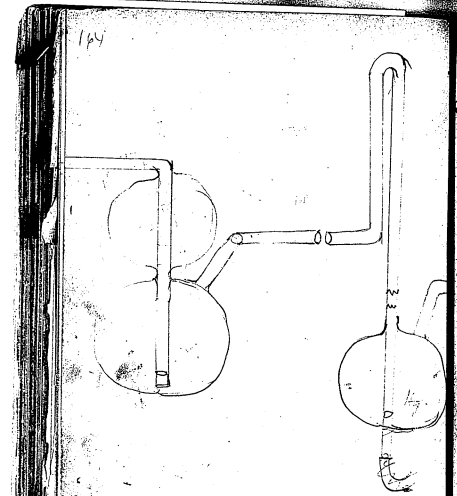


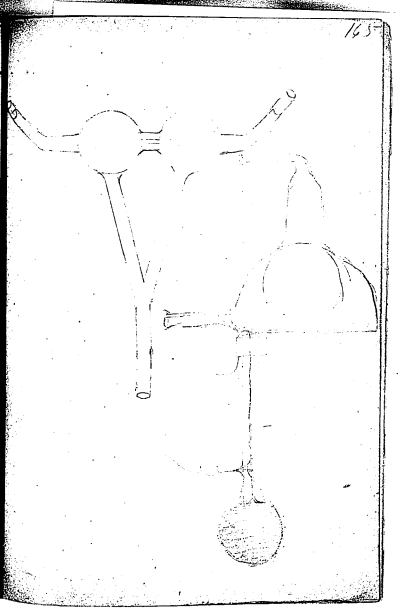


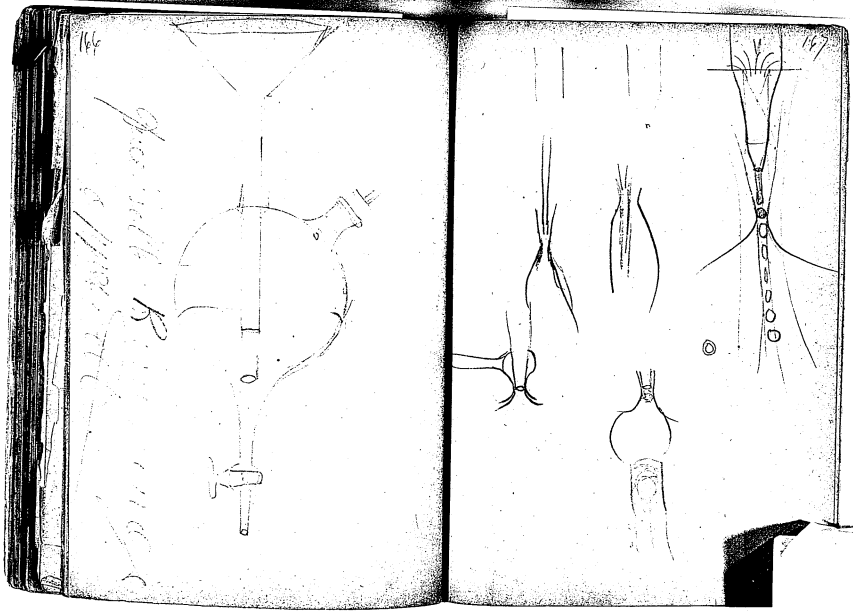





162
163



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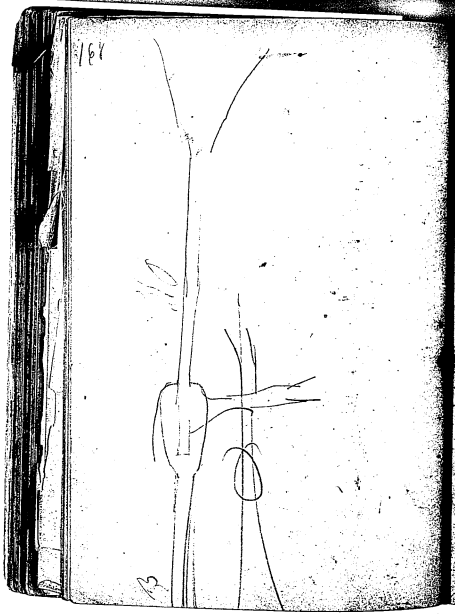
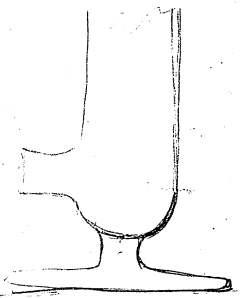
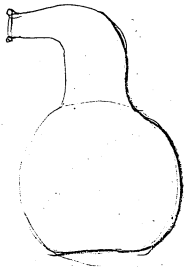
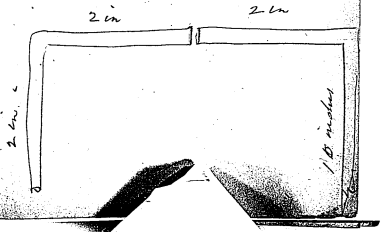
167

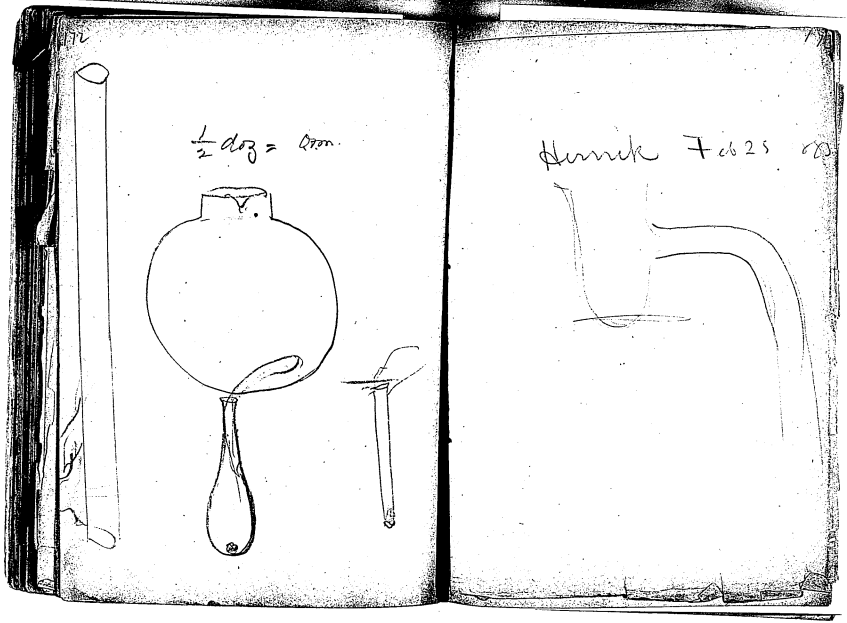


Tube 26 inches long
Chance for rubber bulb
tube on end

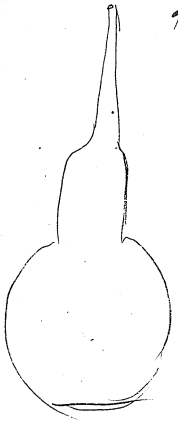




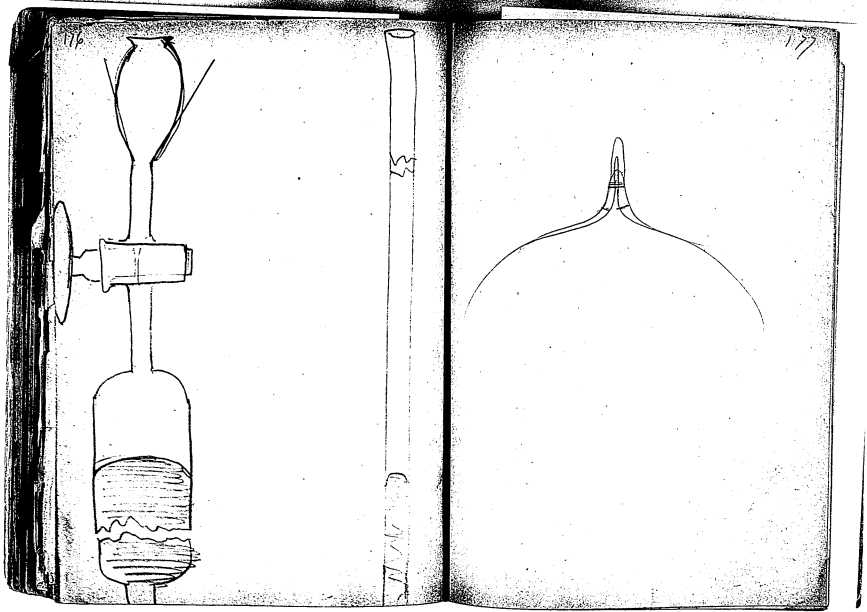

2 in
2 in
2 in
1 1/2 inches

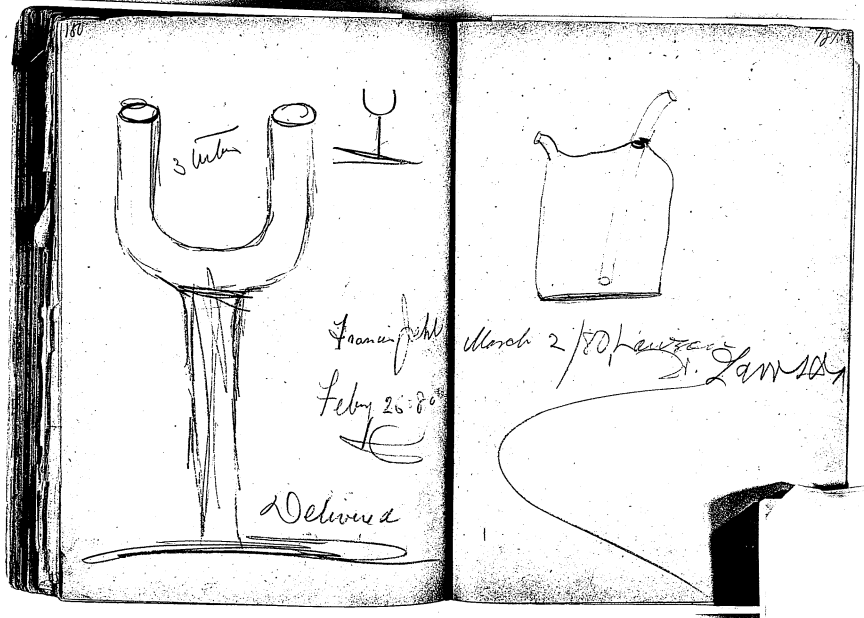

½ dag = 0,5 gram.

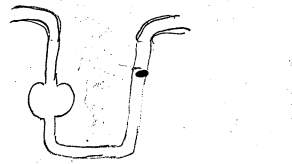
Lawson Feb. 2-6
or any other month



2 doz Offm.



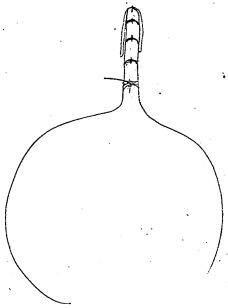

180
3 Tubes
Feby 26: 80
Delivered
March 2/80
St. James

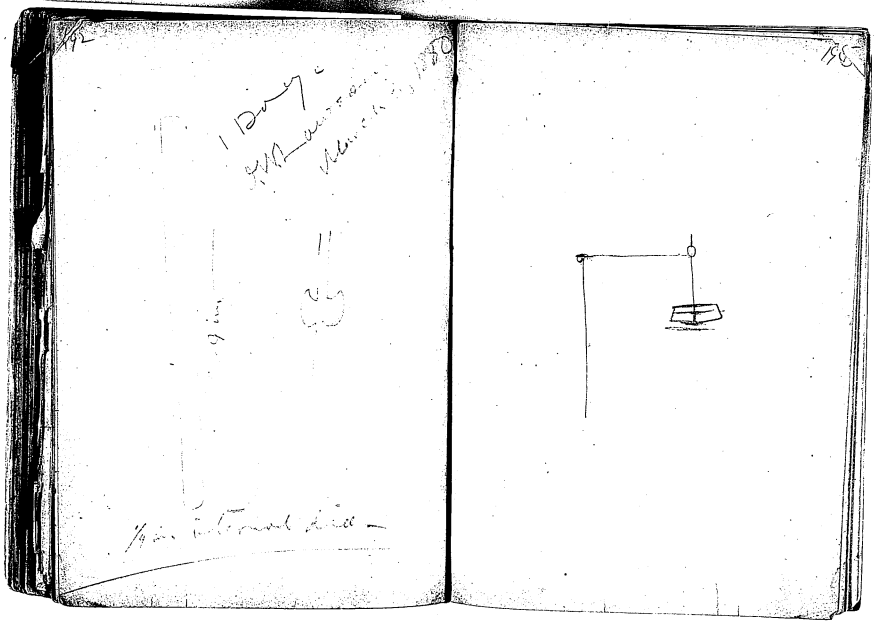


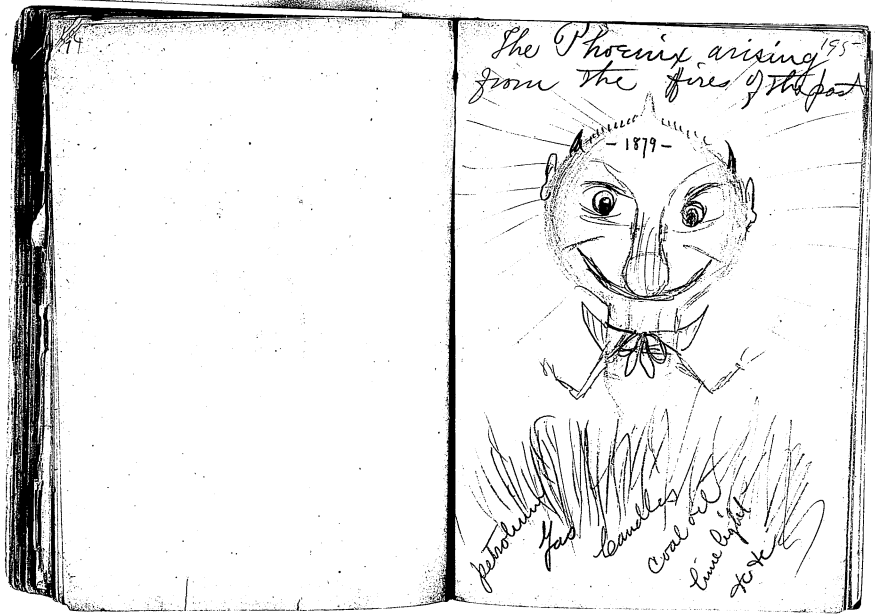
100

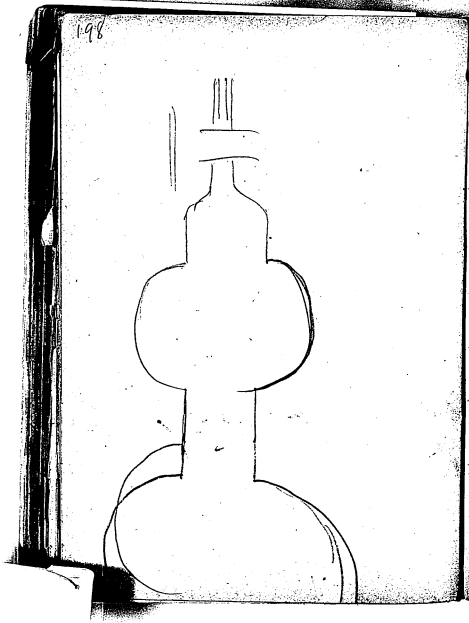
W. Thorpe

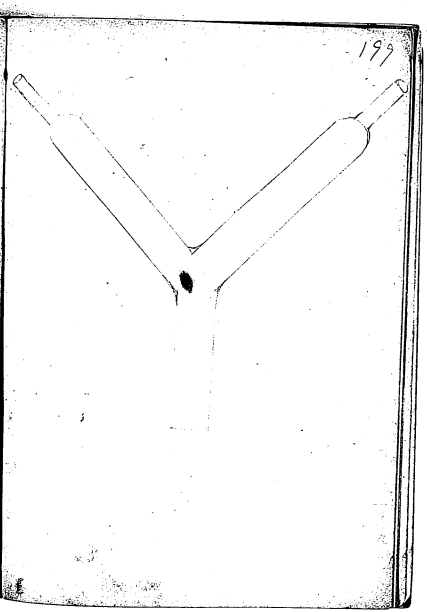
March 5th 1880

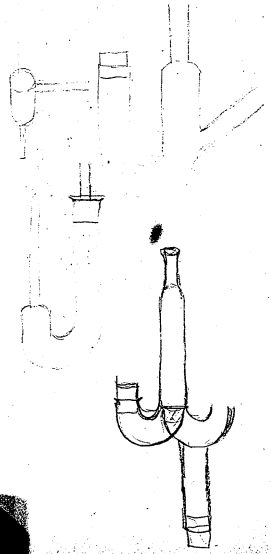


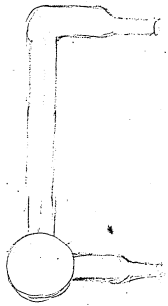


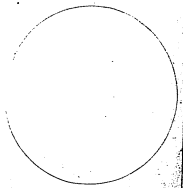

The Phoenix arising from the fires of the past
1879
petroleum
gas
candles
coal oil
time bright

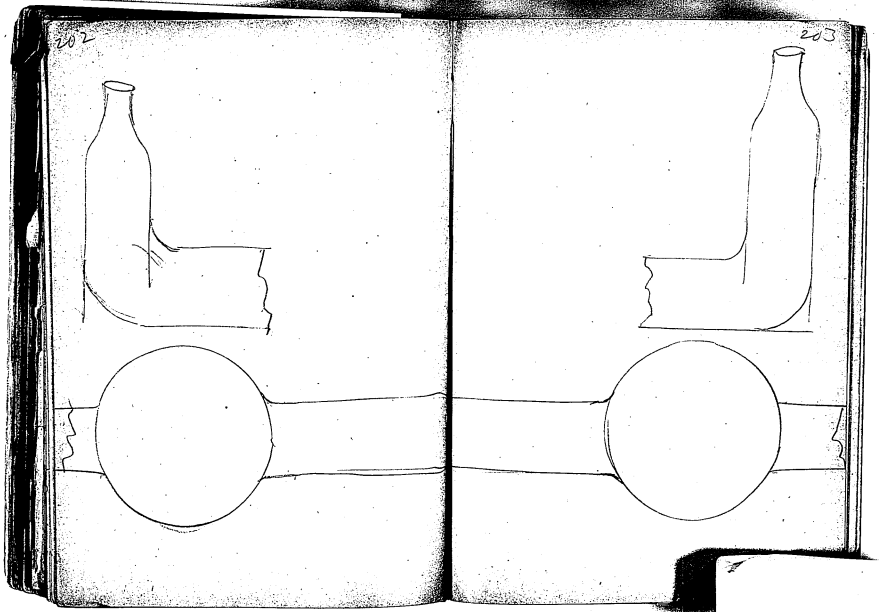


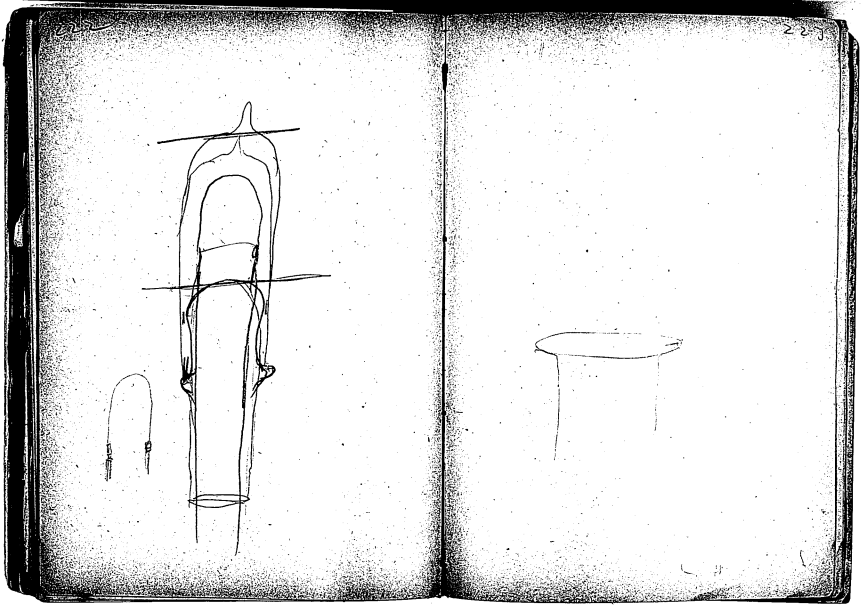









202
203



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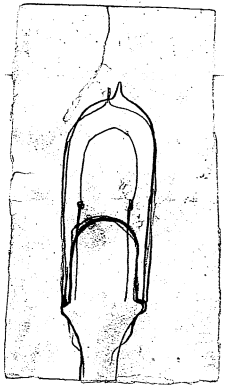
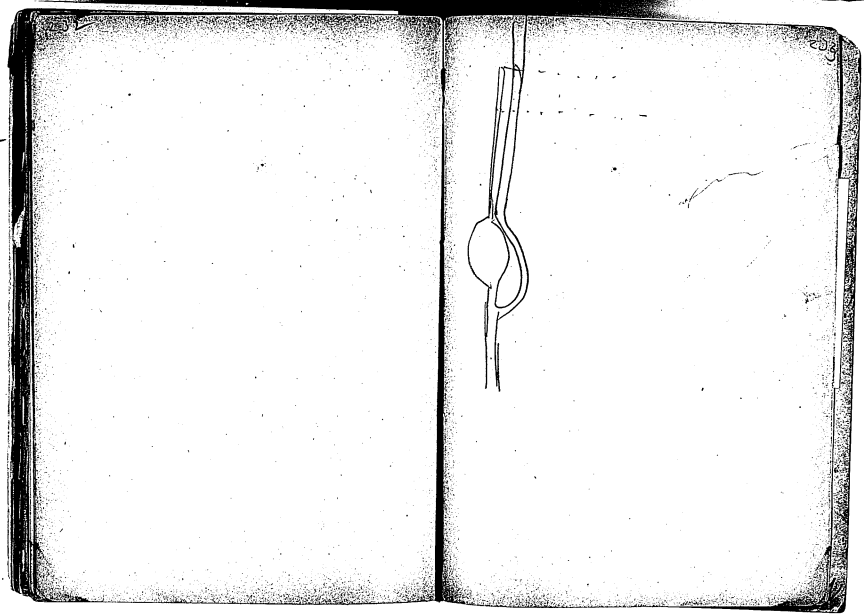
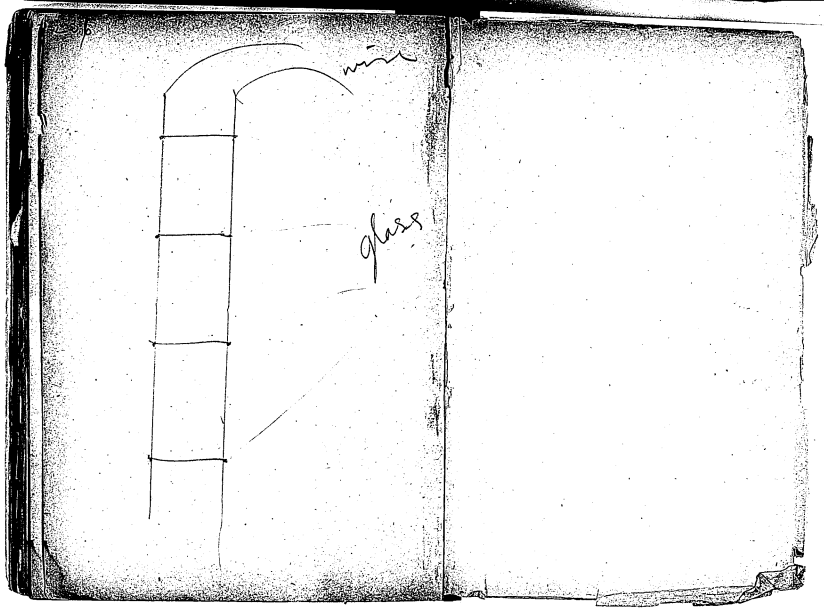





mica
glass

Iodine Conductor

Dry sodium put in
sealed tube with platina
wires each end fused
when fused bottle has
passed through to dry
Iodine

Another man says it
not true

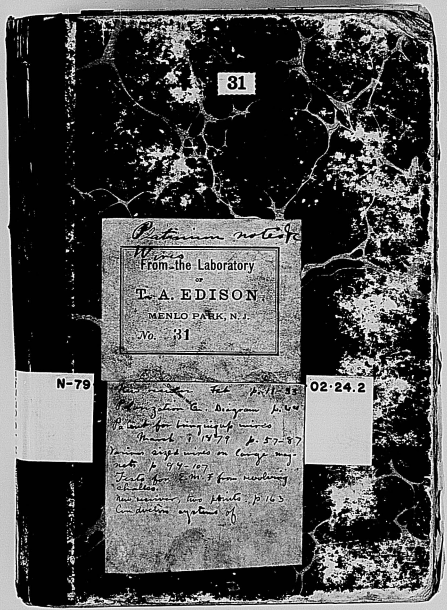
No 36

Menlo Park Notebook #31 [N-79-02-24.2]

This notebook covers the period February-July 1879. Most of the entries are by Edison and Francis Upton. There are also a few entries by Charles Batchelor. Most of the material relates to experiments on electric light and power. Included are drawings of lamps, vacuum pumps, and meters; notes, drawings, and calculations about generators; notes and calculations about electric power distribution; and a patent specification by Edison concerning lamps, which William Carman copied into Volume 3 of Experimental Researches (missing volume). There are also notes and drawings relating to the electromotograph receiver, including notes about chalks for the receiver. The label on the front cover is marked "Platinum notes &c" and "Wires." There is also a table of contents on the cover. The book contains 284 numbered pages.

Blank pages not filmed: 90-91, 268-281, 284.

Missing page numbers: 49-50.


31
Notebook
From the Laboratory
of
T. A. EDISON,
MENLO PARK, N. J.
No. 31
N-79
02·24·2

MO 31

LIBRARY OF THE

BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

GENERAL ELECTRIC.

_____, 189_.

Size of wire in coils

Date Scientific A— when dynamometer described

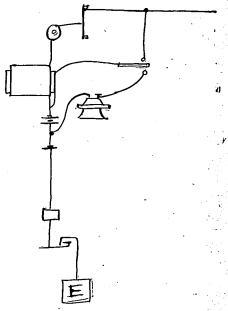
Date Article

Date Morin's dynamometer

Feb 24. 1879

Receiver

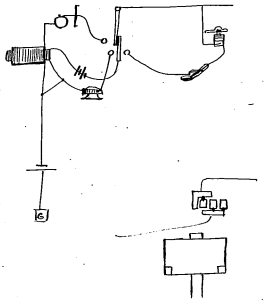
Char/Satchell



Crystal Receiver

Feb 22nd 1919

Chas Pratchett



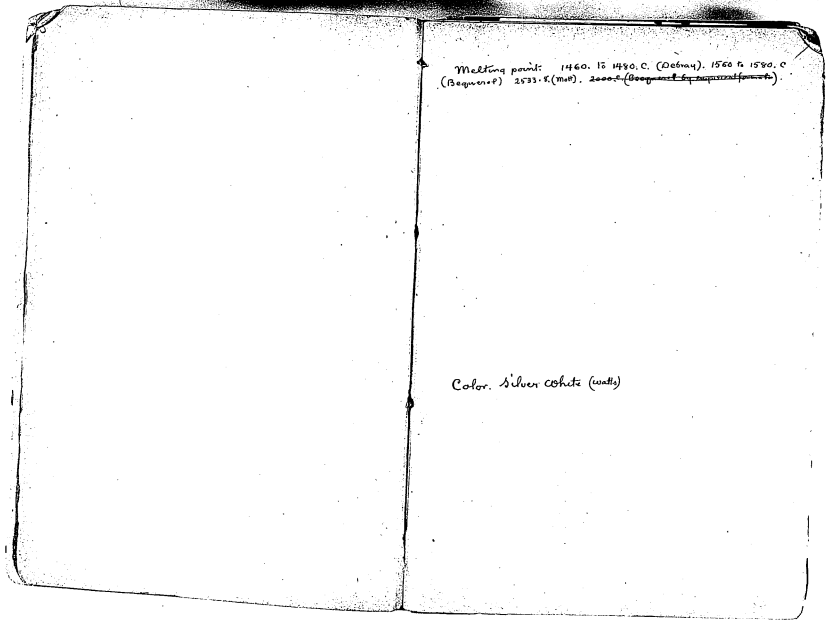
Atomic weight 197. (mitch.) 197.4. (mell) - 198. (Galloway)

Density. Varies from 21.0 to 23.0. (Watts). 21.5 hammered and 21.4 known. (Wollaston) solidified from fusion 21.15. (Deville & Debray). 21.50. (mell)

Somer

Equivalent. 98.7. (MSH). 99.00 (Sharples). 98.94. (Andrews)

Specific heat. 0.33243 (Sharples.)

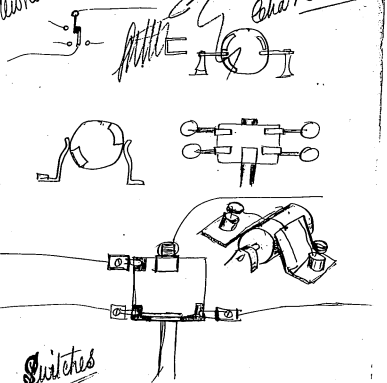


Melting point: 1460. to 1480. C. (Debray). 1560 to 1580. C (Becquerel) 2833. F. (mat). ~~2000 C (Becquerel by augmented powers).~~

Color. Silver white (walls)

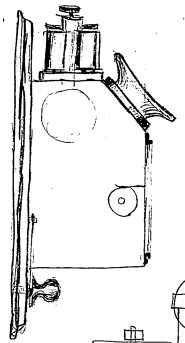
Feb 26th 1919

Characteristics



Neutrocover

Feb 26th 1949
Carbon Detector

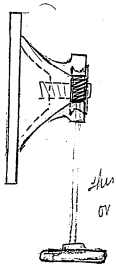


adjustment 3 to 1

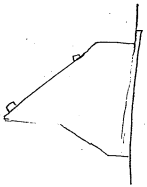
Transmitter adjustment

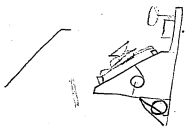
Ft 26 1849

Short Catcher



Use to come below bottom or out on side of liner

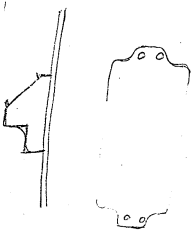


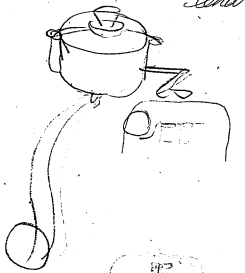


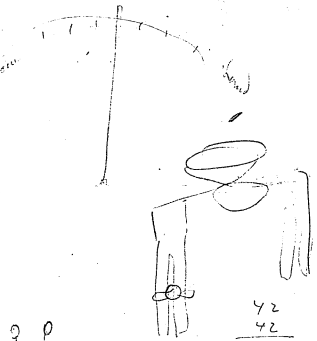
New Receiver

Feb 26 1919

Tesla Patent







49
49
441
196
2401

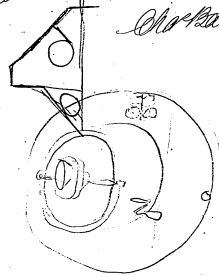
42
42
84
168
1764
1232

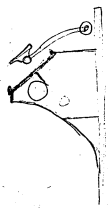
240) 1232 (51
1200
32

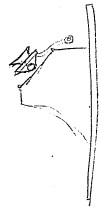
New Receiver

Feb 26 '09 21

Chas Batchelder

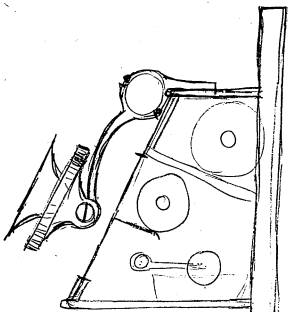


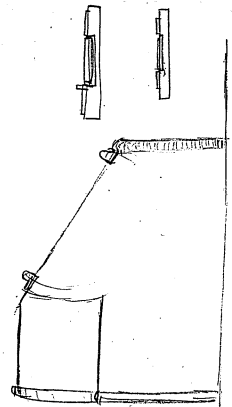




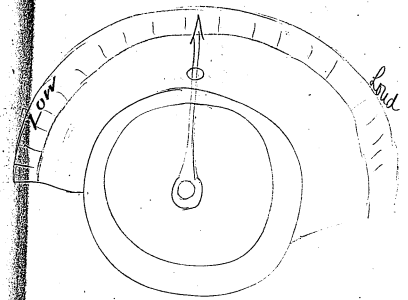
Jiskeeuci Lvov 1979 [2]

Adolf Zatecka





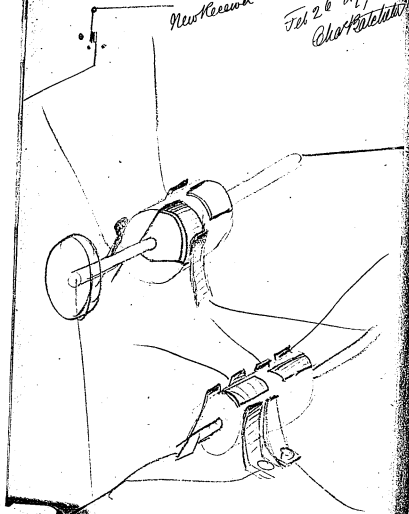
65.	1.8129
65.	1.8129
comp .5	~~10~~ 3.016
44.3	1.6464
	5.5732
	4.5185
11.34 H.P.	1.0547

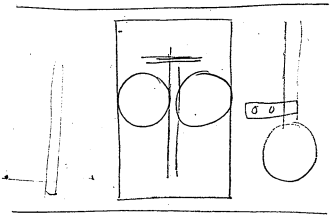


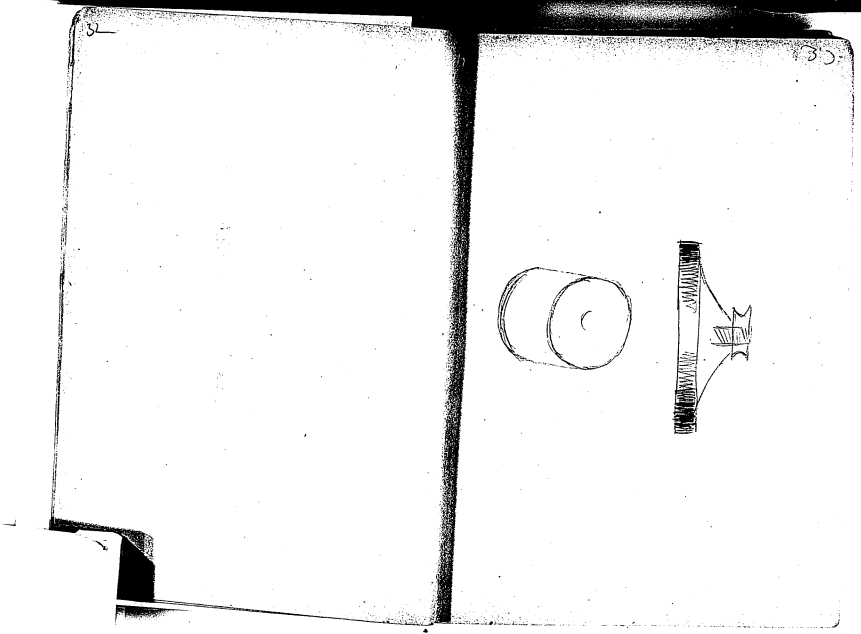
New Reeves

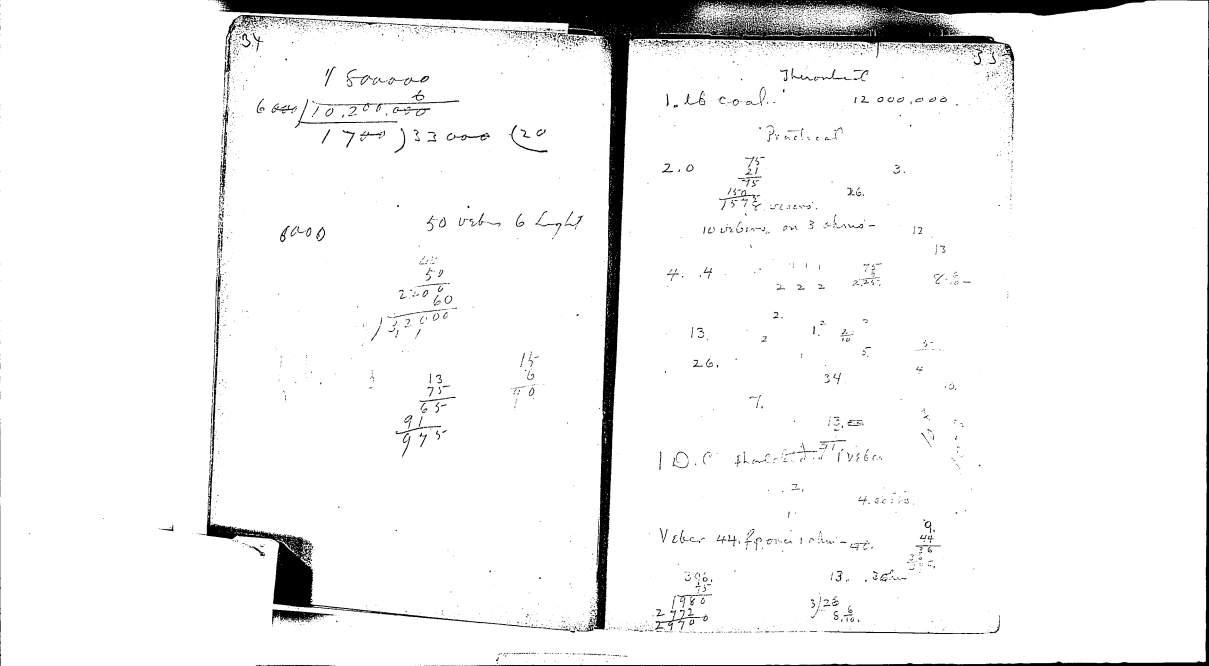
Feb 26 1917

Chas Batchelder









6 lbs each 10 days 10 hours each.

17000 1 lamp.

17000 / 16

1700 40

100 lbs. 4 hrs 10 days

40 1 day.

100 400 1 hour

2000)500

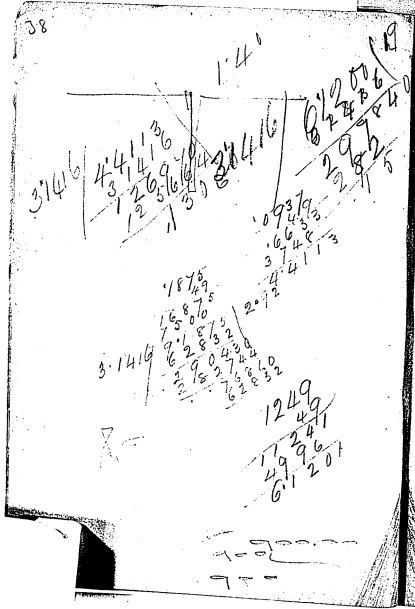
2000)10

2240)10000(44
8960
10400

.0044

less than 1/2 at

1/4 at



38

39

Sigmano

49 commutator blocks each $\frac{1}{8}$ and $\frac{1}{16}$ between

$\frac{3}{16} \times 49 = \frac{147}{16} =$

$.0625 + .1250 = .1875 \times 49 = 9.185$

circumference diameter 2.92

49 com. blocks each $\frac{1}{16} + \frac{1}{32}$ bet.

$= .0625 + .0312 = .0937 \times 49 =$

4.41 circum = 1.4

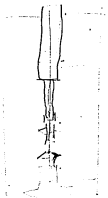
49 com blocks each .0937 and .0312 between = .0937 + .0312

$.1249 \times 49 = 6.12$ circum =

1.95 or about 2 inches = made it 2 inches anyhow

40

5

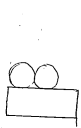


36.

3

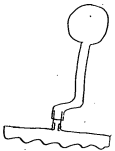
.35. diameter
.39. Length

5/



1 inch long -

42



1500

500 ohm Lamp 193.

1 hp.

SE. ohm R-2.

9,900.

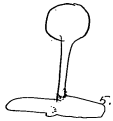
1 ohm hot.

3 Lamps

3 per hp

5

4.



1.1

5.

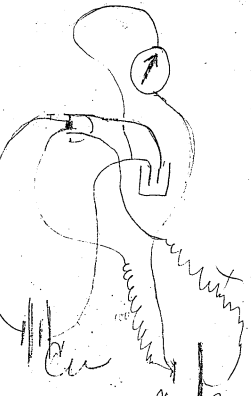
117

13.

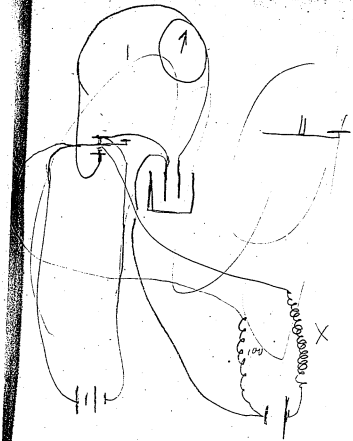
9

117

.9.



Salomon Turn of Cu
$\frac{1}{51}$ of a Daniells



200

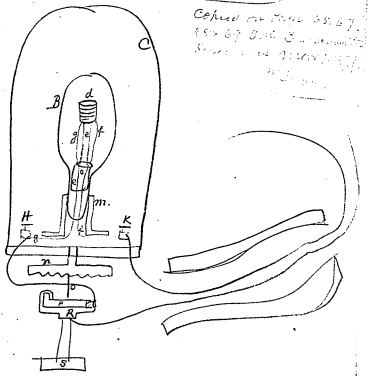
2	100
4	50
8	25
16	$12\frac{1}{2}$
32	$6\frac{1}{4}$
64	$3\frac{1}{8}$
128	

50

$3\frac{1}{8}$

$6\frac{1}{4}$

Patent
March 1 1879



The object of this invention is devise an ~~practical~~ Electric lamp which shall admit of being worked in great numbers on one electric circuit

The invention consists in ~~so~~ placing in a receptacle ~~of~~ ~~of~~ made entirely of glass a body of pyromagnetic wire which is to be brought to incandescence by the passage of the current through it The invention consists in ~~the~~ making a vacuum in the receptacle while the conductor is gradually heated,

The invention further consists in the use of salt of lime, magnesia

Zircon. Cerium Erbia ~~another~~
for coating. the wire which salt
is decomposable by heat, the salts
which are easily decomposed are
the acetates of these metals
The invention further consists
of a vacuum receptacle made entirely
of glass and sealed by melting
the same in combination with an
incandescent conductor, pyromineral of
The invention further consists in
winding ~~the~~ pyromineral coated wire
upon a bobbin of compressed infusible substance
such as lime.
The invention further consists
in placing the vacuum bulb
within another glass receptacle

also closed from the air and employing the expansion of the air between the two receptacles due to the heat of the encircling bobbin, to produce a movement which shall disconnect the lamp from the Electric circuit when its temperature is too great.

B is the vacuum bulb. This bulb is opened at the bottom end and the burner d inserted. and placed in connection with a mercury vacuum pump. the platina wire, g. + f passing through

The openings are connected with a battery and variable resistance coil, while the vacuum is being made the heat of the bobbin is gradually in the course of 1 hour brought from gradually from the temperature of [illegible] upon to ~~[illegible]~~ vivid incandescence when the vacuum is considered practically perfect the ~~[illegible]~~ open end of the tube is melted and sealed the platinum wires ~~[illegible]~~ passing through the glass are sealed - thus I am enabled

to obtain a nearly perfect
vacuum which is permanent
and at the same time gives
the platinum wire a new and
unknown property of great
value in Electric lighting
which is that a platinum wire
which melts in the open air
at a point where it emits a light
equal to
four candle, will when operated
upon as described emit a
light equal to 25 candle,
without fusion. The reason
why the melting point of
the metal is thus raised is

62

63

that in the act of making
the vacuum with the mould
under heat all the gases
which are contained in the
gases is withdrawn, and when
the receptacle is sealed can not
receive when cold hence
unequal ~~[illegible]~~ + sudden
Expansions cannot take
place and the work is never
Cracked but if it is imperfect
becomes as bright as the most
polished silver, an appearance
which cannot be given by

in any other way —
on the other hand it is
known that the metals of
the platinum group
in a surprising degree
the ~~property~~ power of
absorbing within them
many volumes of gas and
it is this sudden expansion
of this gas upon
accession of heat that
disrupts the ~~metal~~ gold into
Cracks which extend nearly
to its centre when the
wire is brought to

a moderate incandescence
in the open air ~~outside the glass~~.
These cracks ~~pierce~~ set up a great resistance
to the passage of the current and
at these points become abnormally
heated hence the platinum wire
easily melts, whereas no such
cracks are noticed when
the wire has been operated
upon in the vacuum tube. The
gases pumped out ~~of~~ is a
cylinder of fine with a small
~~hole~~ spiral ~~on~~ in its external surface
on which the wire is coiled

30
8
7
17
235
2
765

about 30 feet of platinum 69
wire which was coated with
Magnesia oxide is coiled upon
the spool. The wire may
be of any size but I prefer to
use wire .005" of an inch diameter
which will give a resistance
when incandescence of about
750 ohms - by the use of such
high resistance lamps I am
enabled to place a great
number in multiple arc
without bringing the total
resistance of all the lamps
too low to such a low point

as to require a large
main conductor but on the
Contrary am enabled to use
a main conductor of very
moderate dimensions -
~~In large accessory areas~~ in
large another important
point is gained by the use of
lamps of high resistance
as the resistance of the
wires leading from the
main conductors may be
of very moderate dimensions

hence can be placed in the
pipes already used for gas
+ at the same time effect a
great saving in the Cost
of wire -
Still another point gained
is that the high resistance of
the lamps allows all to
be placed in multiple arc
which is the only method
where the maximum economy
is attainable, as the lamps
when connected to the circuit
draws from the central
station just sufficient current

to maintain it at the proper
temperature and if by accident
of want of regularity in the
main current the [illegible]
strength of the current
should increase abnormally
the access of heat to the bi-
thermal regulator immediately
disconnects the lamp entirely
from the circuit, thus
stopping all further consumption
of energy until the
temperature of the lamp

reduced to its normal
Conditions, I will state that
these changes are not
perceptable to the eye
hence the lamp cannot consume
~~only~~ any more Energy
than that required to
~~keep it~~ cause it to emit
a certain light
No loss in economy occurs by
using so large a resistance
because the loss of Energy
is proportional to the radiating
surface Exposed to the air
into temperature and is

independent of the resistance of the wire forming such surface - M is a lime cup into which the small End of the vacuum burner is held. the platina wires pass under it to the binding posts H.R. N is the Vernier regulator operated by the Expansion of the air and [illegible] when the temperature [illegible] the bulbs B expands and presses the diaphragm D outwards & the point O operates the Spring S from R & disconnects the lamp

from the circuit when it remains
until the temperature is reduced
to the normal condition.
The spark upon the points is
very small as I employ
~~Contacts~~ Constant field magnets
at the central station hence
the powerful sparks due to
the secondary current set
up by the weakening of the
powerful field magnet is
avoided
I would mention that the
Secondary tube C might
be made entirely of glass

and the aneroid diaphragm
mounted in the glass
tube be sealed in the Case
or the aneroid itself be made
of glass ~~[illegible]~~ & also seal
that the Globe may be
be opened am a Ingenious
placed between the Case
atten ~~which [illegible]~~
the tube from the bulb
passing down through
the ~~[illegible]~~ base of the instrument
has a sealed expanding
Chamber or cord attached
to it.

Claim -

1st In combination with a vacuum chamber made entirely of glass of a continuous incandescent Conductor and sealed as set forth.

2nd The method herein described of forming Metallic Combinations of their gases in a vacuum + afterward sealing the same

3rd In combination with a sealed vacuum of a bulb of pyroxylin coated wire wound upon an infusible substance.

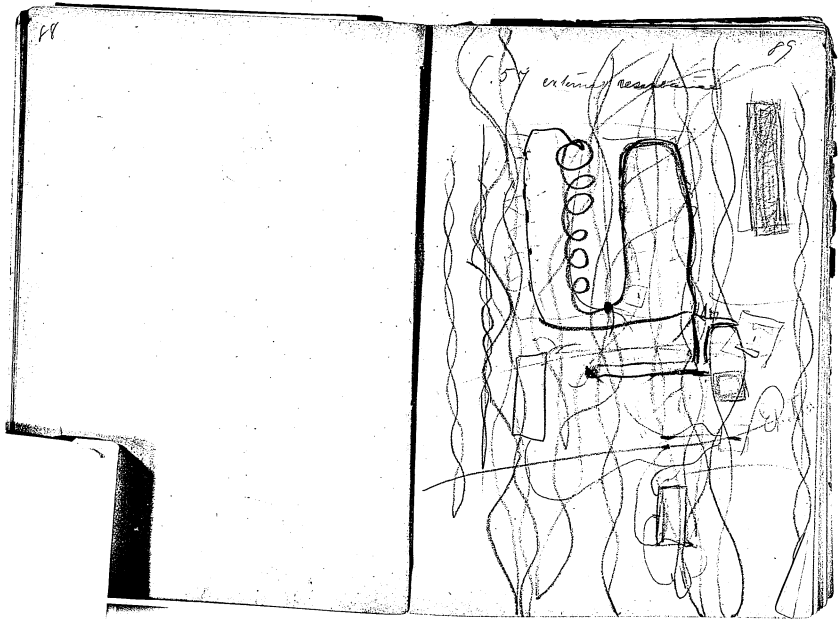
4. The combination of a vacuum bulb containing a Carbon conductor within a second closed chamber for the purpose set forth.

5th - The use of a ~~[illegible]~~ salt of any metal whose oxide is not readily ~~[illegible]~~ fusible & which salt is decomposed by [illegible]

6th - The combination of the sealed conducting bulb B. Chamber C. regulator motor all arranged & operated substantially as set forth.

Witness
H. A. Edison

Mch 1879.



8/9 11/1

99/11 9/1

1/5-00,

4. 6. 12.

1/2 8 16.

10, ÷ 2 1/2.

10.

20. 4.

2.

1/2 1/1

1.

15 2.

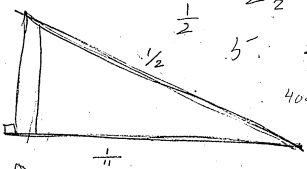
8/120. 1/2

8/960, 11

19 11

1 3/4. 4.

25



1600/15

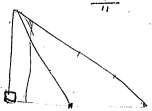
1/2 2 1/2

1/2 5 20

400

1/11

1



1/6.

4.

20,

94

Wire no 5

.220
.13
.233

72
.233
30 turns
491 feet
.146
71.7 lbs
.001459
.104 Ohms

1.8573
10.6326
2.4899
.2014
2.6913
T.1644
1.8557
3.1641
T.0198

273
6.125 .7871
6.358 .8033
.0162

26913
162
27075

Turns per Ohm 4.68 wire
2952
feet per Ohm 4681

2.4899
T.0198
3.4701

3.6702
2.7075
9627
T.3674
P.3301

9.11 layers per one Ohm

2.4899
.9627
3.4526

2830 turns per Ohm

2.14 in thick

685 lbs per Ohm 2.8359

No. 6

.203
13
.216

72
.216
333 turns
~~350 feet~~
.127
~~434 lbs.~~
.00201

1.8573
10.6655
2.8228
.0214
2.5442
T.1934
1.4376
3.3032
2.9408

528.8

2.5226
.2014
2.7232
T.0934
685.5 lbs
1.8166
3.3032
.1131 Ohms
T.1198
2.5228
25'29 turns per Ohm
3.4030

2.6968
497 lbs per Ohm

9J

No. Turns

~~72~~ 1.8573
.47 10.3279
~~153.~~ 2.1852

72 1.8573
.193 10.7144
373. turns 2.5717
593 feet .2014
.098 2.7731
2.9912
58.1 lbs. 1.7643
.00325 3.5119
~~1558~~ 1.2762
.1858 Ohms 2.5717
turns per Ohm 1970 3.2955
307 lbs per Ohm 2.4881

~~4.57~~
~~15~~
~~4.10~~
180
73
193

10.8 turns
.165
13
.178

72 1.8573
.178 10.7496
404.8 2.6069
.2014
.643. 2.8083
.0823 3.9154
52.9 lbs 1.7237
.00461 3.6637
.244 Ohms 1.3874
2.6069
165.7 turns per Ohm 3.2195
217 lbs per Ohm 2.3373

91

No. 12 wire
109
13
122

72 1.8572
.122 10.9136
590 Turns 2.7708
.2014
938 feet 2.9722
.0359 2.5490
33.7 lbs. 1.5212
.0242 2.3838
.803 Ohms T.9050
2.7708
734 Turns per ohm 2.8658
52.1 lbs per ohm 1.7172

2.0294
10.9136
T.9430
1.5212
1.4642

No. 13 wire
95
12
107

72 1.8573
.107 10.9706
673 Turns 2.8279
.2014
1070 feet 3.0293
.0273 2.4362
29.2 lbs 1.4655
.04195 2.6227
1.225 Ohms .0882
2.8279
549 Turns per ohm 2.7397
23.8 lbs per ohm 1.3773

89

No. 14 wire

.093
.012
.095
10.9706
3.9777
7.9483
1.4658
1.4138

25.92

1.9483/2
1.8966

.0273 2.4362
2.3328

11.0223
2.9191
1.9414
2.4362

3.3776
1.9414/2
1.8828
2.4362
2.3180

72 1.8573
.095 10.0223
758 ~~454~~ lbs 2.8796
.2014
1235 ~~555~~ feet 3.0910
.0208 3.1810
25.66 ~~3.28~~ 1.4091
.0721 2.8571
184 Ohms .2662
2.8796
410 turns for 2.6134
73.9 lbs for 1.1439

No. 15 wire

72
12
84

72 1.8573
.084 11.0857
857 turns 2.9330
.2014
1365 feet 3.1344
.0156 2.1931
21.25 lbs 1.3275
~~5157~~

.1271 1.1038
2.7 Ohms .4313
2.9330
317 turns for 2.5017
7.89 lbs for .8972

No. 16 wire

.069
.011
.076

72 1.8573
.076 11.1192
947 turns 2.9765
.2014
1505 feet 3.1779
.0127 $\bar{2}$.1038
19.13 1.2817
.1914 $\bar{1}$.2817
~~2.7 .4332~~
3.66 .5634
2.9765
259 turns for Ohm 2.4131
5.23 Ohms for Ohm .7183

No. 17 wire

.058
.011
.069

72 1.8573
.069 11.1612
1042 3.0185
.2014
1658. 3.2199
.00971 $\bar{3}$.9868
16.1 1.2067
.331 $\bar{1}$.5198
5.328 .7265
3.0185
195 turns for Ohm 2.2920
3.02 Ohms for Ohm .4802

No. 18 wire

49
10
59

72 1.8573
.059 12.2291
1220 3.0864
.2014
1940 feet 3.2878
.00726 3.8609
1407 lbs 1.1487
.592 1.7709
8.31 Ohms 9196
3.0864
147 Turns per Ohm 2.1668
7.64 lbs per Ohm .2291

No. 19

42
9
51

72. 1.8573
51 11.2924
3.1497
.2014
3.3521
3.7267
1.0788
.0404
1.1192
3.1497
2.0305
1.9596

72 1.8573

1410
3.3888
2250
3.7267
1.098 .0404
13.17
20.28 Ohms 1.3073

107 Turns per Ohm
.911 lbs per Ohm

106

No. 20

35
8
43

72 1.8573
.043 11.3665
1675. turns 3.2238
.2014
2651 feet 3.4252
.0037 3.5682
9.85 lbs .9934
2.278 .3568
~~227~~ 1.8502
22.4 3.2238
74.7 turns per in 1.8736
.44 lbs per ohm 1.6432

No. 21 wire

107

32
8
~~24~~
40

1.8573
~~11.6795~~
~~2498~~ ~~3.4785~~
11.3979
2265. turns 3.2552
.2014
2860 feet 3.4566
.00309 3.4900
8.89 lbs .9466
3.257 .5125
28.78 ohms 1.4591
3.2552
62.5 turns per in 1.7961
.314 lbs per ohm 1.4975

No 2 2 inch

28
7
35

72 1.8573
.035 11.4559
2047 feet 3.3132
.2014
3270 feet 3.5146
.00237 3.3747
7.75 lbs .8893
5.55 .7443
43. Ohms 1.6336
3.3132
478 Turns for 1 Ohm 1.6796
.18 lbs per Ohm 7.2557

No 2 3 inch

25
6
31

72 1.8573
.031 11.5086
232 Ohms 3.3659
.2014
3672 feet 3.5673
.00189 3.2765
6.98 lbs .8438
8.74 .9415
61. Ohms 1.7853
3.3659
38.1 Turns per Ohm 1.5806
.114 lbs per Ohm 1.0585

5 Ohms

117 2.0682
117 2.0682
44.5 1.6484

5.7848
5 0.6990
5.0858

121.600 5.0858
4.5185
.5673

3.7 H.P

9/33.000
3.555

4 5.7848
.6021
5.1827 152000
4.5185
.6642 4.6 H.P

3 5.7848
.4771
5.3077
4.5185
.8892 7.7 H.P

2 5.7848
.3010
5.4838
4.5185 9.2 H.P
.9653

75 Volts

75 1.8751
75 1.8751
44.5 1.6484

5,3986
2 0.3010

5,0976
3300 4,5785

.5191

3.8 H.P

~~10~~

16 1.2041
1.9 0.2784

.9253

8.4 per H.P.

14.6

2.3 H.P

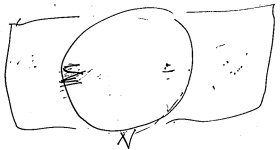
1.9 : 2.3 :: 1 : 1.61 ca

16 1.2041
2.3 0.3617
1.9 0.2787 -10

1.2870

19 lamps

38
4
5 | 152
30.4



~~T.000~~

.25
.25
3.1416

4) .0196
.0049

$\bar{1}.3979$
$\bar{1}.3979$
.4971
$\bar{1}.2929$

4)18
4725
9
~~42525~~

4725
25

1.6744
1.3979
3.0723

49

1.6744
1.6902
3.3646

121

1.6744
2.0828
3.7572

5718

1.6744
1.1139
13 1.1139
13 1.1139
4.9022

575
7.9482

11819
9
10629

1.6744
17 1 2304
17 1 2304
4.1356

27220
4
108880

18900
4
75600
4
302400

27220
4
108880
4
435520

6800
4
27200

9261
4
38044

9261
4
37044

2315
4
9260

2096
4
48384

6800
4
27200
4
108800

1123
498
625

1997
1123
874

3120
1997
1123
4490
3120
1370

6113
4490
1623

7984
6113
1873

10100
7984
2116

874
625
249

1123
874
249

1370
1123
247

1623
1370
253

1873
1623
250

2116
1873
243

119

12480
10100
2380
2116
264

15080
12480
2600
2380
220

17960
15080
2880
2600
280

21070
17960
3210
2880
330

24450
21070
3380
3210
170

2984
4
37936

28070
24450
3620
3380
240

33696
28070
5370
3620
2750

31966
28070
3896
3620
276

36040
34940
2500
4600
3898
704

3
36040
31966
4074
3898
176

40430
36040
4390
4074
316

45030
40430
4600
4390
210

49896
45030
4860
4600
260

55010
49890
5120
4860
260

498
4
1992
4
8
70

1997
4
7988

7984
4
31936
4
127744

7984
4
31936

1123
4
4492
4
17968
4
71872
4
287488
4
1149952

3/4
1 1/2
3

1123
9
10107

10106
9
90900
2

44904
19560

6113
4
24452
4
97800

~~590000~~

60320
55010
5310
5120
190

15080
4
60320

49920
4
80

31204
12480
4
49920
4
199680

15080
4
60320

65980
60320
5666
5310
350

71850
65980
5870
5660
210

1104
490
614

1963 859
1104 614
859 245

1028
1963 1105
1105 859
1227 246
994
2330

14840
12270
2570
2330
240

4417
3068
1349
1084
6013
4417
1596
1249
247

2330
2084
244

7854
6013
1841
1596
251

.9940
.7854
2086
1841
239

199600
4
798400

189.07
4
756.28
4
3025.12
4
12100.48
4
48401.72

189.07
47265

47.2675

9

425.4

3.58304
.95424
4.53728

189907
47.2

2.27660
.60206
1.67454
4
5

1.67449
7
1.67456
.95424
2.62880
.95424
3.58304
297
7

3/8 3.58304

425.4
4
1701.63
4
6806.52
4
27226.08
4
108904.32

---

1 1/8 wt 1.67456
5/8 25 1.39754
3.07210
188
3 22

1180.55
4
4722.20
4
18888.80
4
75555.20

7/8 1.67456
49 1.69020
3.36476

2316.1
4
9264

15/8

382 8
4
1531 2.

425
189
236

756
425
331
236
95

1181
756
425
330
94

1702
1181
521
425
96

2316
1702
614
521
93

3025
2316
709
614
95

3828
3025
803
709
94

4722
3828
894
803
91

4722
894
96
5712
894
96
6702
96
6808

6808
894
96
96
96
7990
96
92698

9264
7989
1275
9264
93
10632
93
93
1275
17093

24/8

22 11/8 = 1 3/8

5712
4
22848
188
22848
94
22754
18859
2 3885
1932
20821

12100
10634
1466
95
12100
13661
1466
95
95
15317
13658
1659
94
15317
17070
1659
94
94
18917
18889
17060
19

75555
48402
33

27226
22848
4378
94
14284
2142
24990

9264
4
37056

755555
4
302220

108904
4
435616

215280
2640 feet
2.64 times 1000 feet

189.07
2.64
49922
37842
18907
144.804
9
1123

499.2
4
1996.8
4
7987.2
4
31948.8
4
127795.2

2 27660
.42260
2.69820
.60206
2.09614
.95424
3.05038

1123
4
4492
4
17968
4
71872
4
287488
4
1,149.952

130

25

2.09614
1.39794
3.49408

3119.6
4
12478.4
4
49913.6
4
199654.4
4
798.617649

2.09614
1.69020
3.78634

6114.13
4
24456.52

2.09614
81 1.90849
4.00463

10107.
40428.

2.09614
121 2.08279
4.17893
69
24

15098
4
60392

131

4|.1654
4|.04135
4|.01034
4|.002585
.0006462

2|5280
2.64

.1654
2.64
6616
9924
3308
436656

4|1654
4

1654
4
9|6616
4|.07351
4|.01838
4|.004595
4|.001149
4|.0002872
.0000718

1123
4992
6238

1997
1123
864
6238
2482

8120
1997
1123
864
259

4992
3120
1372
1123
249

6114
4492
1622
1372
250

7987
6114
1873
1622
251

10107
7987
2120
1873
147

12478
10107
2371
2120
251

15098
12478
2620
2371
249

17968
15098
2870
2620
250

24457
250
24207
17968
6239
3119
21087

31948
250
31698
24457
7241
3620
28077

40428
31850
40178
31948
218230
4115
31948
36063.

7987

3620
500
4120
500
4615

40428
4615
45043.

24457
4
97828

49914
4617
545531
5000
60392
4617

5717

545531
5617
60148
6200
348
60392
6200
66592
6700
7 2292

60392
127795
250
127545
718

71872
× 250
71622
60392
11230
5615
66007

6616
35
33080
33232
0

6616/25 = 6616/100 × 4/1

6616 × 4/100
26464
.008169
.002042

25 | 6616 (
4 | .026646
4 | .006615
4 | .001654
4 | .000413 5
.000104 4

81 | 6616 (.008169
648
136
81
550
486
640

49 | .6616 (1350
49
171
147
246
245
10
392
8

13350
675 00
6750
66150

4 | 01350
4 | .003375
4 | .000843 8
4 | .000210 9
.000052 43

121 | .6616 (.005468
605
566
484
820
726
940

4 | .005468
.001367

.165400
.073510
.091890
.032160

.073510
.041350
.032160
.014990
.041350
.026460
.014890
.008080

.026460
.018380
.008080
.004880

~~.026460~~
.018380
.013500
~~.004880~~
.003160

.013500
.010340
.003160
.002171
.010340
.008169
.002171

.059730
.017250
.042480

.017280
.006810
.010440

.006810
.004200
.002610

.004200
.001720
.002480

.001720
.000989
731
.000989

.165400
.165400

~~435619~~
~~30222~~

27226
24990
2236
2142

24990
22848
2042
2027
22848
20821
2027
1932
20821
18889
1932
1829
18889
17060
1829

94
115
95
103

1654060

.008169
.006615
.001554

.606615
.005468
1147

000989
000517
.000472

.002171
.001554
.000517

.001554
1147
.000407

.042480
.010440
.002610
.002480
.000731
.000472

.059730
.017270
.006810
.004200
.001720
.000989
.00

$$\frac{d}{dx}\left(\frac{1}{x^2}\right) = \frac{dx^{-2}}{dx} = -2x^{-3}\,dx$$

$$x^2 = 2x$$

1654
4
.6616 .6616
4
26464

13
13
39
13
169

.6616
169

1.82060
2.22789
3.59271

.003915

15
15
75
15
225

17
17
119
17
289
2

1.82060
2.35218
3.46842

1.82060
2.46090
3.35970

361

1.82060
2.55751
3.26309

19
19
171
19
361

21
21
21
42
441

1.82060
2.64444
3.17616

23
23
69
46
529

1.82060
2.72419
3.09641

4 | 1.4367
4 | 1.1097 5
4 | 1.0273 125
4 | 1.0068 27
.0017 07

.4367
4
9 | 1.7468
4 | 1.1941
4 | 1.0485 27
1.0121 4
.0030 350
.0007 5587
.0001 897

.4367 3

~~4367~~
~~25~~

1.7468 .24224
25 1.3975 4
~~1.6401 8~~
6987 2.8447 0

4 | 6.6987
4 | 1.0174 7
4 | 1.0043 67
1.0010 92
.0002 730

.24224
49 | 1.6902 20
2.5520 4

4 | .03565
1.0089 13
.0022 28

9 | 1.1941
1.0215 800

.24224
81 | 1.9084 9
2.3337 5

2158

121 | .24224
2.08279
2.15945

1444
003610

13
13
39
13
169

.24224
2.22789
2.01435

21
8

21
21
42
441

.24224
2.64444
3.59780

3961

15
15
75
15
225

OE
245 | .24224
2.38917
3.85307

7130

9 | 6987
7764

25 | .24224
7.39794
8.84430

9 | 8797
97

225 | .24224
2.35218
3.89006

7776 | .95425
2.84431

N6

4367
4
17468

24224

25

.24224
25 1.39794
2.84430
~~.07056~~ 1.84470

6993

.24224
25 1,39794
2.84430
6987 .95424
3,89006

007783

---

2 1/2

17
17
119
17
289

.24224
.28892 .46090
3,78134

6044

18
18
144
18
324

.24224
324 2.5105 5
3,73169

,60539 1 5391

2156
5390

19
19
171
19
361

.24224
361 2.55751
3,68473

4839

145

23
23
69
46
529

.24224
529 | 2.72246
3 51878

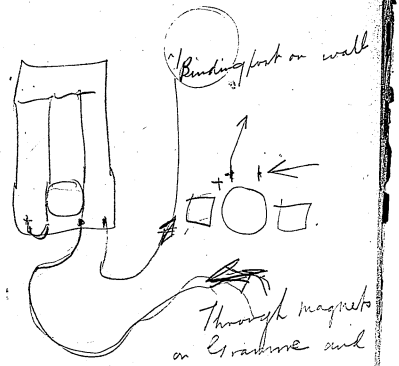
330

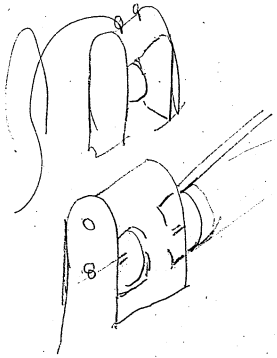
6046.5
2
12093 0
2

6046.5
4
6

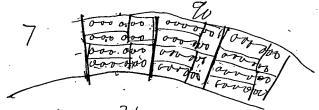
6046.5

6046.5
4
24186 0





.035 in diameter .014 covering



7

90

7

3/4 .75 .75 .75

Chalks Test of E. M. Jan

Pt 6 oz Bangta

Spirit 6 grs Sodium Amalgam

½ oz Caustic Soda

15 R with Pt

10 R Cu

and jumps when first put on Rubbing no effect

No. 10 2 oz Chalk

¾ oz Caustic Na

9 grs Calomel

a sharp throw to Right a deflection of 5 R Pt

Rubbing but little effect

20 R Cu to 50 R

No. 2 1/15

About 30 grs Sulphide Hg

Cinnabar Na O in Chalk well ground

2 R Pt

On rubbing thrown off quite sharp.

10 R Cu to 25 in groove

No. Regulus 2 R Pt

but initial added long and worked in thoroughly after Na O added and worked ½ hour. With Cu on white tiles scarcely anything; on the black

30 to 40 R

Rubbing sends to R

154

No. 5 1/2 Flower Subject
Metallic Hog No 0.
Lith mill Ground
O. Rt
White very little Pink
Ts 20 Q

L Cu
R. yp

No 12 5-8 Q Rt
200 X Cu
Off scale on black
this one quite moist

155

L

12

16
6
9
6
9
12.

2/10

11.

5 & Rt

Rubbing no effect

150 – 250 R Cu

4 Sulphur only

Acetate Hg Na O

Regular ground

200 R Rt

Rt Hg scale when on groove with

50 R Cu outside

150 – 150 R Cu groove

3 Muriate Rt. Ox Hg

Sulphate Soda Chalk

White powder on surface

very small dilation until scraped away

40 R Rt

150 – 200 R Cu

Rt 6 oz Barytes

1 oz 13 part Soda Amalgam

50 R Rt in the groove

Rubbing no effect

10 R – 10 R Cu

No. 5

Mainly Rk ox Hg
Lamp black Soda Chalk

No 23

6 oz. Boracic
16 Mint. 12 grs Soda Amalgam
1/2 Canetic Soda
50 L in groove Pt.
10 - 20 L outside
10-20 L Cu in groove
0 outside
Rubbing in effect.

No. 4 Mercurious Oxide 117
Chalk & Soda
10-20 R Pt
50 on cuttail = 250 when
resaped with Cu.

15 Black ox Hg Mint
Chalk Soda

Pt. 5 L rubbing mint to right
Cu. 200 - 300 R
The cu. dressed Pt. 200 is right
with carring gradually down to 150

160

16 Probably 50 grs.
Acetate of Lead in H_2O
Counter Soda. Rg Chalk
Well ground

Pt 3 L Rubbing no effect
Cu 5 R 12 250 Ohms

13 H_2O
Sulphate Rg. Chalk
Well ground

3 L

161

Chalk No. 1 7100 Ohms
Pt 25 L No. 2 13000 Ohms
Cu

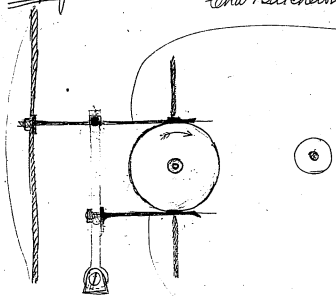
185 8000

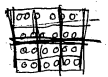
Tea. 20 Ohms
Tea 150 Ohms

Mr Logograph

June 22 1879

Chas Batchelor





36

56

81

9/16 : 8/16 :

9/16 8/16

$\sqrt{8.1} = 35$

$\frac{1}{4}$ $\frac{256}{5}$ X 35

23
35
128
76
60
2

16
16
96
64
4) 256

$\frac{81}{64}$ $\frac{81}{64}$ 35 9/16

9/16 9/16 31

81
35
405
243
64) 2835

33 33
33 3
33

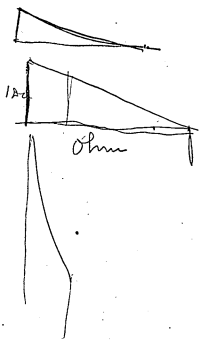
8) 2
4) 400

33.5 33.9
34

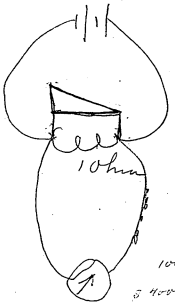
.0339 m

C

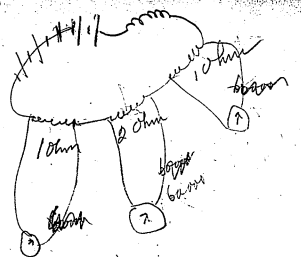
Cu wire
200 feet 1.865 Ohms
.0339 inches in diameter

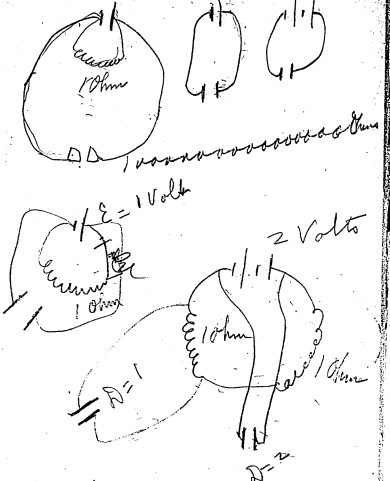


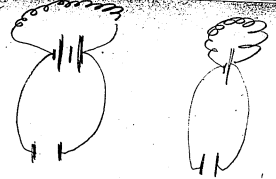
35



72


1 Ohm
1 Ohm
1 Ohm
1
2
2
1


1 Ohm
E = 1 Volt
1 Ohm
2 Volts
1 Ohm
1 Ohm
D = 1
D = 2



33000
5
165.000 comp 44.3
9

5.2175
8.2536
0.9542
4.5253
2.2626

183 Volts

1/2 Ohm machine
Taking out five H.P.
outside & Ohms

$\frac{1}{9} \quad 0 \cdot \frac{E^2}{R} 44.3 = X$

$E^2 = \frac{X}{44.3}$

$E = \sqrt{\quad}$

33000
4
132000

5.1206
8.3536
0.9542
4.4284
2.2142

183 Volts

174

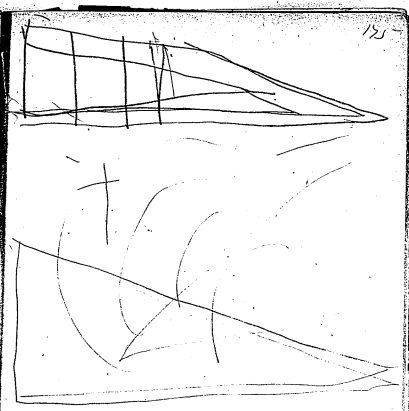
4.5

33.000
4
132.000

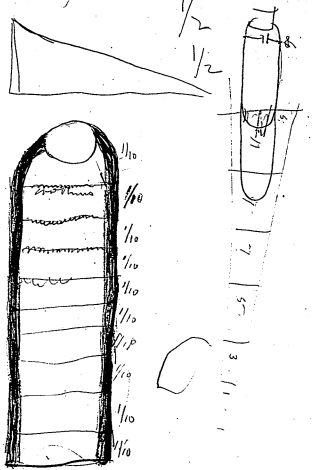
5.1206
8.0530
0.1532
4.1274
2.0637

4.5

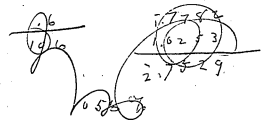
115 Volts



175



1/2 Ohm Machine



$\frac{1.5}{11.5} \times \frac{1}{3} = \frac{.5}{11.5} = \frac{.1}{2.3}$

$\frac{1}{23}$ .6383

.043 x 1.6 = 1.6 at outs of machine

1/10 1/100 1/1000

100 Volts
4.34
95.66

178

$\frac{1}{1000}$ 95.66

95.66
95.564

$\frac{1}{1000}$ 96

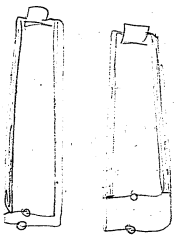
95468

95

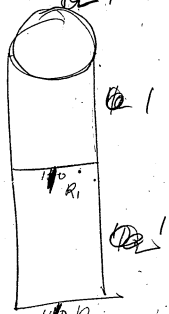
95373

95

95.66



179

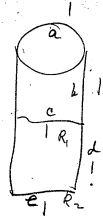


$R_1 = 3$

$R_2 = 4$

$\frac{12}{7}$ = Total

180



$a+c = r$

$a+c = r$

$R_1 = 3$

$R_2 = 4$

$\frac{12}{7}$ = Total

R_1

$(a+b+c)$

$(r+d)$

$R_1 R_2$

$R_2 = (a+b+d+c)$

$= (b+d+r$

$(a+b)(b+d+r)$

$2r+2d$

$(a)(d+c)$

$c+d+c$

$a+b+\frac{r(d+r)}{2r+d}$

181

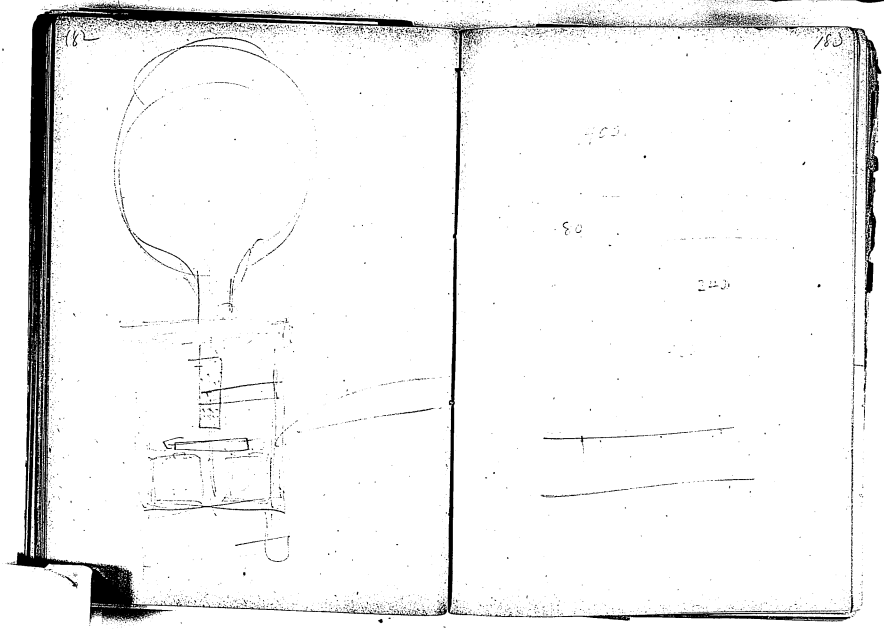
$$\frac{1}{a+b+\frac{r(d+r)}{2r+d}}$$

$$\frac{a+b}{a+b+\frac{r(d+r)}{2r+d}} \quad X \frac{d}{a}$$

$$\frac{a+b}{a+b+\frac{r(d+r)}{2r+d}}$$

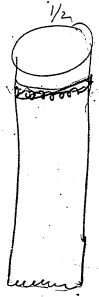
$$\frac{1+1}{2+\frac{2}{3}} = \frac{2}{\frac{8}{3}} = \frac{6}{8} = \frac{3}{4}$$

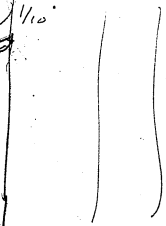
$$\frac{1+1}{2+\frac{2}{3}}$$

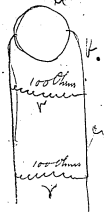


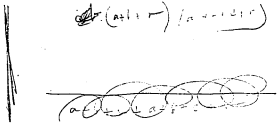
10 lamps in ~~Ohm~~

Conduction



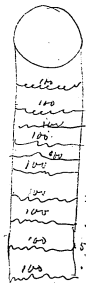






$$\frac{RR}{R+R} \qquad a+b+\frac{r(c+r)}{2r+c}$$

$$\frac{a+b}{a+b+\frac{r(c+r)}{c+2r}} \sqrt{\frac{c}{c+r}}$$



$$R_T = \frac{R_1 R_2}{R_1 + R_2}$$

100.1 × 100 = 10010 / 200.1

10010 / 200.1 × 100 = 1001000 / 200.1

100 + 100 / 200.1 = 50.0249

150.075 / 50.0249 = 3.00

5002.49 / 150.075 = 33.344

45007 / 5176 / 4507 / 6660 / 60 / 0

33.344 X 100 / 133344) 3

33344 × 33344 = 1.112998

3.52303 × 2.12998 = 1.39805

250.075

25.0075 X 100 / 125.0375

1.39805

100.1 X 100 / 100.1 + 100 = 100.1 X 100 / 200.1 = 10010 / 200.1

4.00243 × 2.30125 = 1.67919

50.025

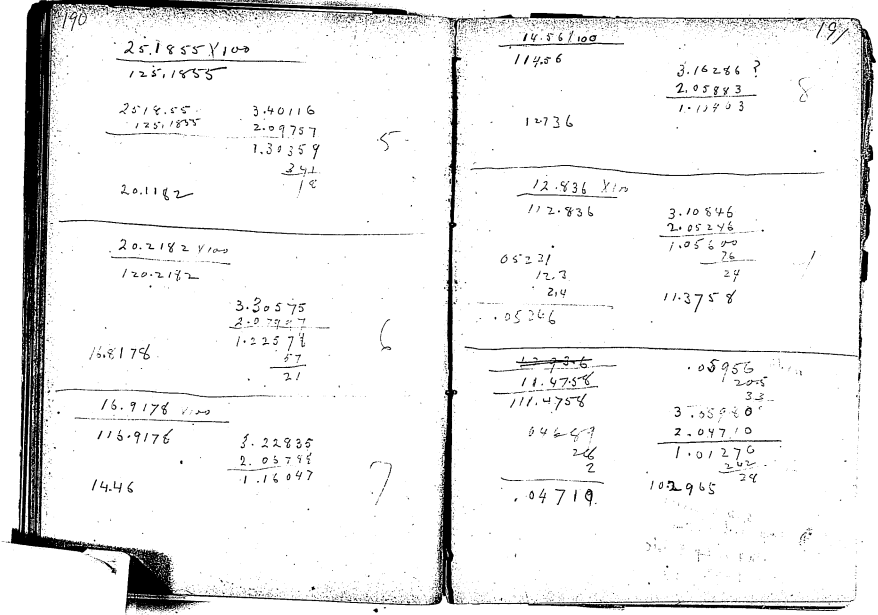
50.125 X 100 / 150.125 = 5012.5 / 150.125

3.70006 × 2.17345 = 1.52331

33.499 X 100 / 133.499 = 3348.9 / 133.499

3.52471 × 2.12376 = 1.33995

25.0855



192

½ Ohms

					Volts
15.4	99	½	100.1	10.30	94.4
14.7	98.2		100.2	11.38	93.7
14.4	97.4		100.3	12.74	92.9
14	96.7		100.4	14.46	92.3
13.6	96.1		100.5	16.82	91.7
13.4	95.7		100.6	20.12	91.3
13.2	95.3		100.7	25.09	90.9
13	95.		100.8	33.39	90.7
13	94.8	½	100.9	50.25	90.5
12.9	94	½	101.	100.	90.4

Ohms: 32.28, 31.5, 31.2

O.K. Dec. 15

82

61

Total
100 Volts
10.30
.1
.5
10.90 Ohms

10 Ohms: 10.30 / 10.90

1.01284
1.03743
1.97541

.944

Work 28 pages 192

10 lamps each 100 Ohms

Σ m.f one Lp 99 Volts

Σ m.f = 90.9 Volts

9.95664
43
9.95621
.934

193

.944 1.97541

11.28 1.05614
11.48 8.94009
1.99623
.937

.937 1.97164
12.74 1.10517
comp 12.84 8.89143 - 10
1.96824
.924

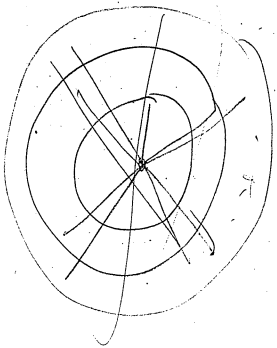
1.96824
14.46 1.16017
comp 14.56 8.83484
1.99525
.923

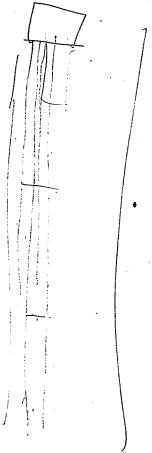
1.99525
15.82 1.22383
15.92 8.77130 - 8
1.95269
.917

20.12 1.33353
20.22 8.62427
1.95780
.913

25.09 1.39950
25.19 8.55827
1.95780
.919

33.39 130
33.49
1.95750
86
1.95664
.935





.33

.33

.33

.33

.33

100 / 100 .33 — 1

50 / 5033 — 2

3333 / 3366 — 3

25 / 2533 — 4

20 / 20.33 — 5

2

2.00143

1.99857 — 99.6
1.99714 — 99.3
1.99428 — 98

1.69897

1.70186

1.99711 — 99.3
1.99422 — 98.6
1.98844 — 97.3

1.52288

1.53719

1.99569 — 99.0
1.99138 — 98.0
1.98276 — 96.1

1.39794

1.40370

1.99424 — 98.6
1.98848 — 97.3
1.97696 — 94.8

1.30103

1.31825

99282 — 98.3
98364 — 96.3
94728 — 92.7

47

98. 6 1/100

1656 / 1699 b

2216
2302
9918
9828
9556

98.
96.1
92.4

12.50 / 12.858 d

.0969
.1028
.9887
.9774
.9548

10.8 / 10.953

1
1.0141
.9859
.9718
.9436

96.6
93.7
87.8

190

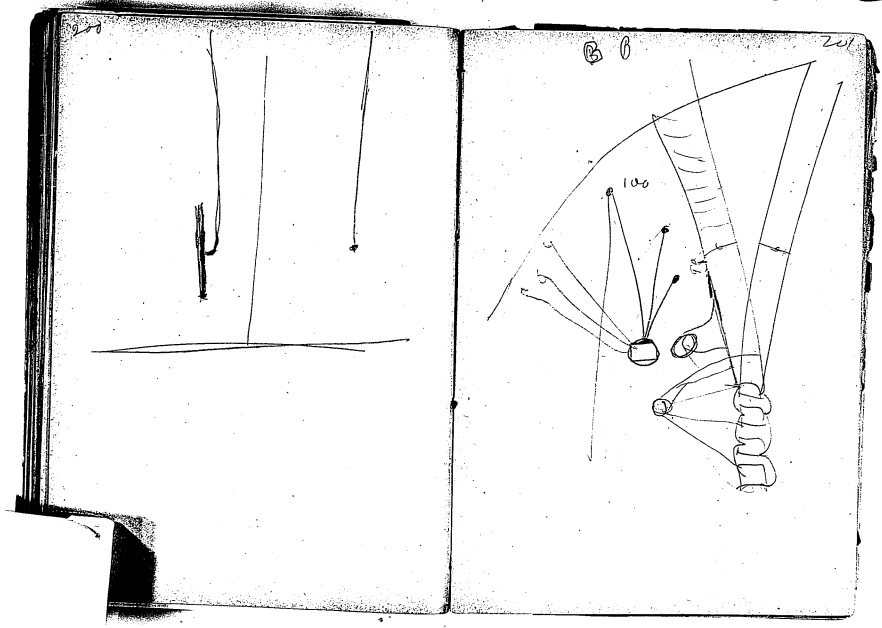
1 ohm 1/7
1/34
10
1 ohm 1/8
1/27
10
1 ohm
1/19
10
1 ohm
1/10 ohm
10

$R = \frac{R_1 R_2}{R + R_2}$

$\frac{1/90}{1/10 + 1/9} = \frac{1/90}{19/90} = \frac{1}{19}$

$\frac{1/19 \times 1/8}{1/8 + 1/19} = \frac{1}{27}$

$\frac{1}{7} + \frac{1}{34} = \frac{1}{40}$



847

~~335~~

.0335 in = A

9.71
994
1965
9.824 .9921

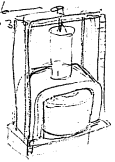
comp .335 8.4815 –
comp 35.5 8.4815 –
Eng 200 2.3010

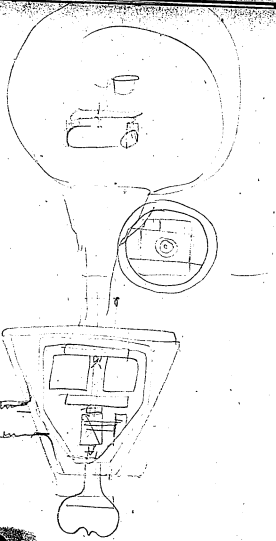
0.2561

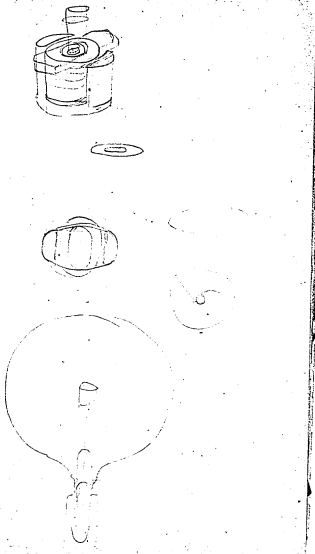
1.81
18
1.99

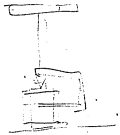
83
32
51
5
9/255
27.2
.0338
2176
816
.1033

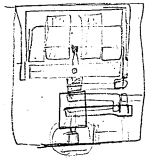
160
100
9/5
5/9

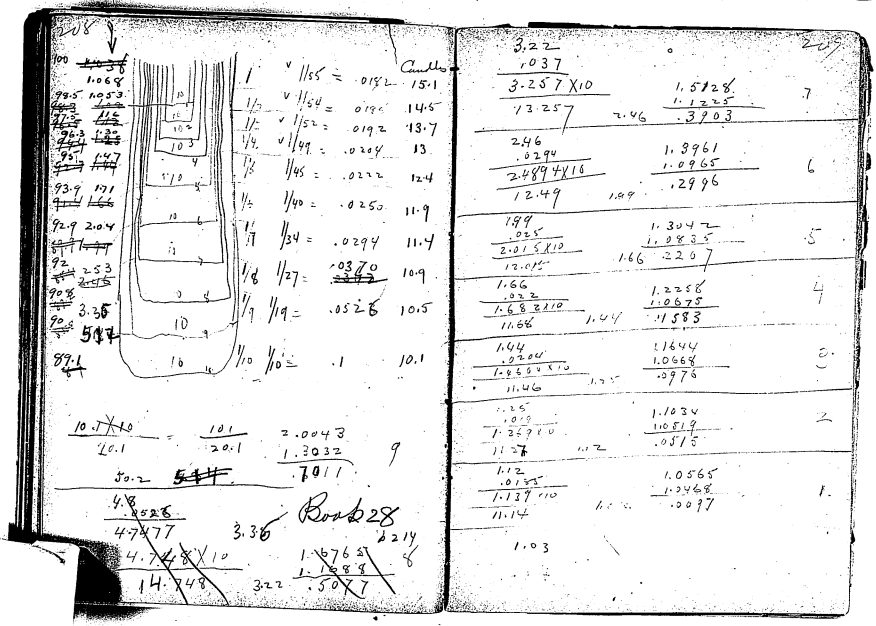


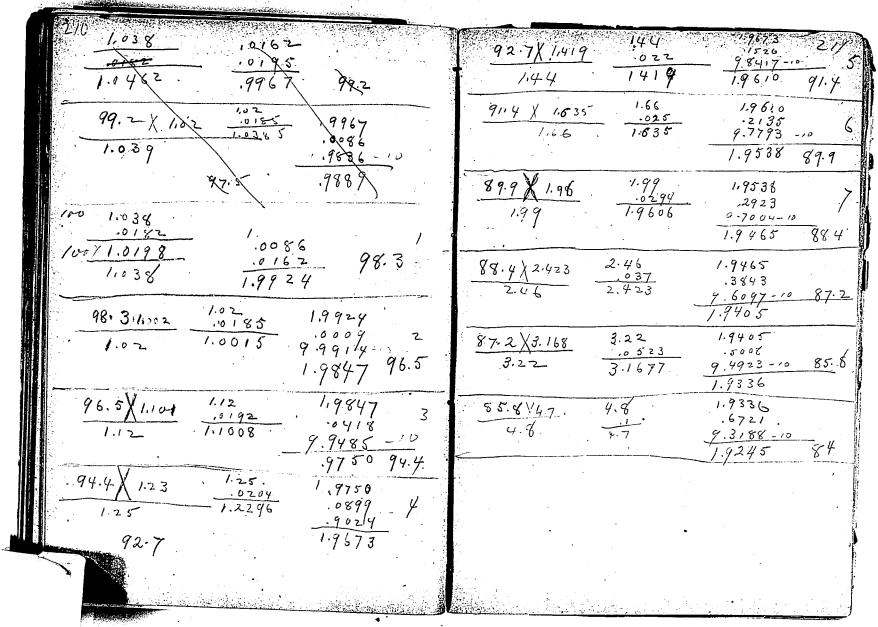


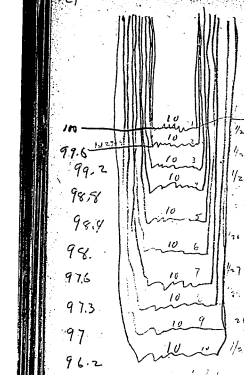











100
97.8
99.2
98.8
98.4
98.
97.6
97.3
97
96.2
10
10
10

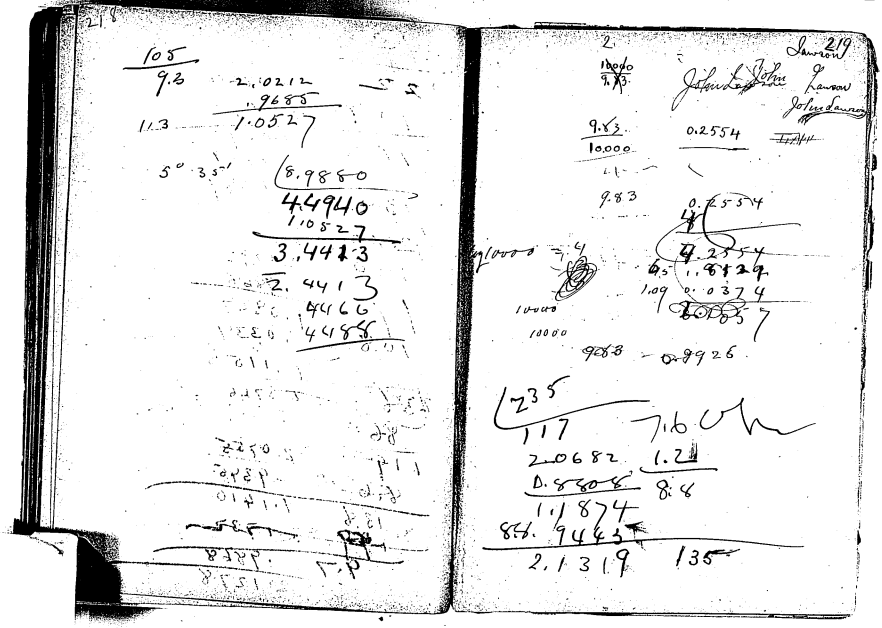
6.6 .8195
21.3 1.3284
2.1479

266
128 2.1072
14.3 1.1553
1.1 .9519
15.4 1.1875
2.1394

~~256~~ 253
~~128~~ 126
126 2.1004
12.8 1.1072
1.. 1.9932
13.9 1.1430
2.1362

244
122 2.0864
10.7 1.0294
17.8 1.0570
1.0719
2.1289
134

240
120 2.0792
.9868
9.7 1.0824
10.8 .0334
1.1158
236 2.3746
86
119 2.0755
8.6 .9345
13.8 1.1410
~~1.1732~~
9.7 .9868
2.1278



220

9.83

Square of no. of $\frac{1}{1000}$ in in diam.

Let a = no. of $\frac{1}{1000}$ in. in diam.

& B = no of feet taken (1)

$\left(\frac{9.83}{a^2}\right) B \times 1.09$ = the resistance of pure Cu. at 75° F.

This divided by the resistance of wire as measured give the per cent.

221

9.83 45 = 17129

9.83 45 = 69115

17129) 4433335 (26 = 9977/17129

17129) 10274743 (6 = 10224 6931/17129

17129) 1087493 (6 = 10 2204 / 2 6960.8

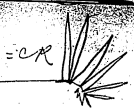
9.83 16129

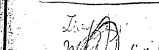
0.992554
4.207606
4.784948
1.653213
2.438161
0.637426
2.475587
-2.477121
4.952708

20736
207365
241
4.207606
-2.475585 -1
-2.477121
1.998464
.9964

222

$E = CR$ $E = CR$





[illegible]

[illegible]

[illegible]

1.5
11.5
7.5
1.5
2.25
5
11.25

44.3
11.3
1329
443
443
500.59

44.3
4

50
53

50 1.699.0
54.6 1.737.2
53 8.275.6
1.111.8

51.5

50 cc. H_2O + 5 grammes
Hydro di-Phos. 49.6

~~53 53~~

50
53

50 C.C. solution weighs 51.5
49.6
Increase 1.9

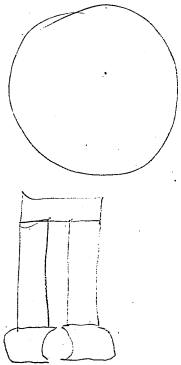
Saturated 52.6
49.6
3.0

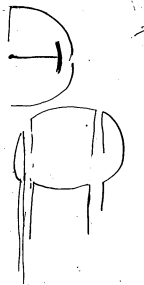
1.9 : 3. :: 1 : 5 :
3
19) 150 (78
133
17 0

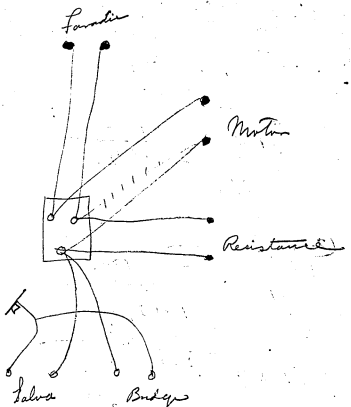
7.8 Grammes in
Solution

7.8	.8921
52.6	1.7210
	9.1711

14.8






Motion
Resistance
Valve
Bridge

233.3 — 116 — 8.7 — 13.3 Webers — 9.8 — 130 Volts

2.0645 · .9395 · 1.1250 · .9912 · 2.1162 · 460

720 · 870 · 890 · 627 · 135 · 682 · 1317 · 658

225 — 112 — 7.6 — 14.3 — 8.9 — 127

141.000 · 2.0492 · .8921 · 1.1571 · .9494 · 2.1065

214 — 109

223 — 7 ohms

112 — 7 — 8.1

2.0492 · .8451 · 1.2041 · .9085 · 2.1126

8.95 lbs required to field

890 — 654 — 232

with field 2.7834 · 232 · 2.3655 · 3.1489

3.1489 · 3.0050 · .9561

904 lbs

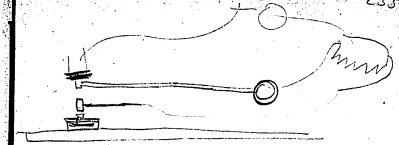
232

655
650
1315
= 2.7

890
.657
= 233

690
695

233



.33
2.7882
.43674
5.1556

1.3
4.2
5.5

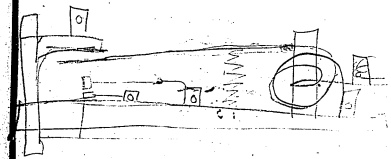
1.5000
2.28
+7882
2.36.74
5.1556

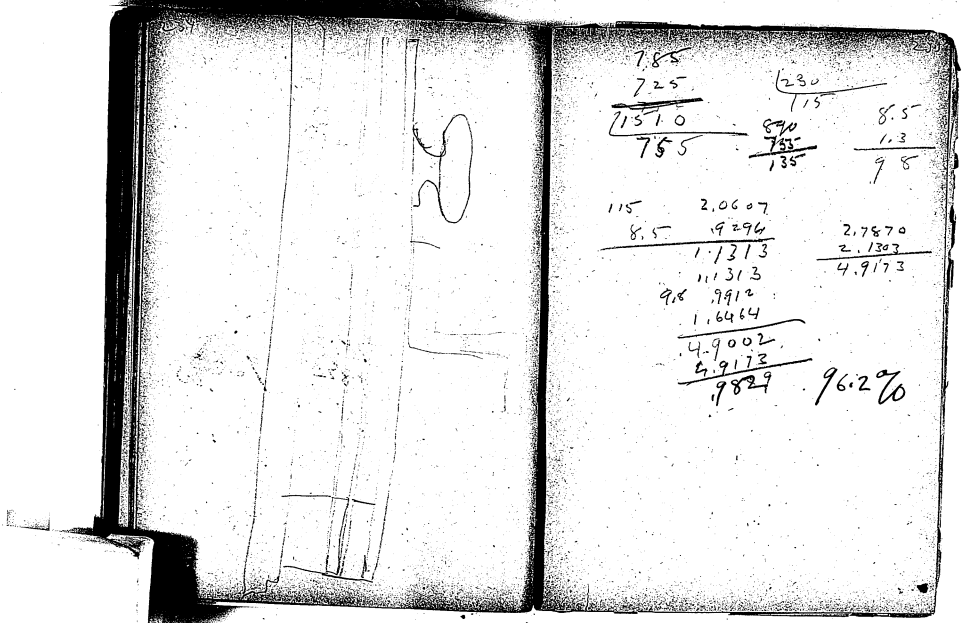
19.1
95
= 2

1.9777
1.3545
5.15 1.3545
.7400
1.64464

4.0254
1.5502
5.5756
.9402

87%





7.85
7.25
7510
755

230
115
690
690
135

8.5
1.3
95

115 2,0607
8.5 .9296
1.1313
11.313
9.8 .9912
1.6464
4.9002
4.9173
.9829

2,7870
2.1303
4.9173

96.2%

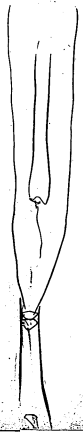
89) 201 (2 25
178
230
178
520
445
750

108
5
54

112
108
896
112
12.09.

12.1
54
175
2
35

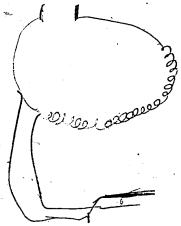
33.000

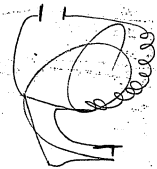


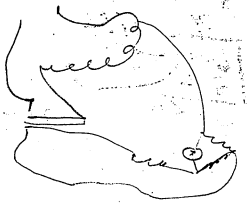
920
880
875
913
805
880
788

No Magnet machine running free — 900 lbs

Field magneton 894.







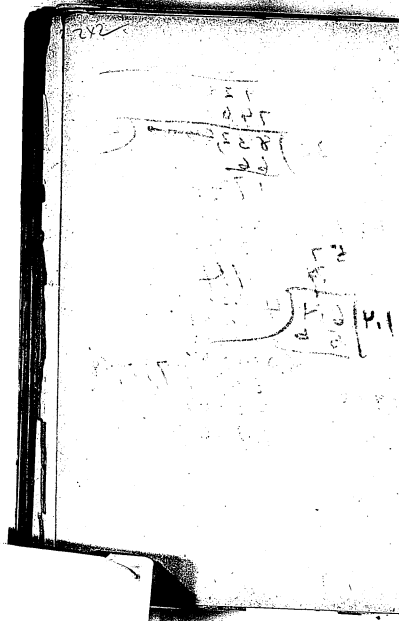
185.000
4.5
925 000
1420
33 | 8325.000 (25
66
580
2

57
.7
1.4 | 6.4 | 4.5
5 6
80

5.7 | 8
7

5.47
5.8 2

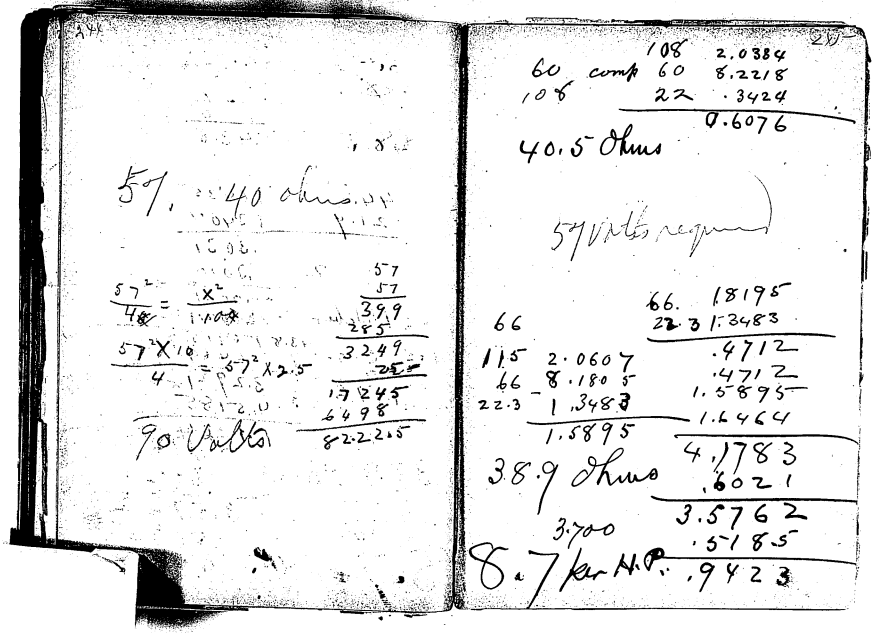
2 | 11.42
5.71



154

44 — 21.9 / 2 / 43.8

44.	1.6435
21.9	1.3404
	.3031
2	.2010
	.0021
1 Nickel	.0021
43.8	1.6415
	1.6464
1916	3.2921
	4.5185
	1.7264


57. 40 ohms
57² = x²
48 1.10x
57² x 10 = 57² x 2.5
4
90 Volts
57
57
399
285
3249
25
17245
6498
82.2225
20
108 2.0334
60 comp 60 8.2218
108 22 .3424
0.6076
40.5 Ohms
57 Volts required
66. 1.8195
66 22.3 1.3483
.4712
115 2.0607 .4712
66 8.1805 1.5895
22.3 1.3483 1.9464
1.5895
4.1783
38.9 Ohms .6021
3.5762
3.700 .5185
8.7 per H.P. .9423

100 Volts
100

4430 ft. lbs

~~4.3~~

90	1.9542	1.9542
90	1.9542	1.9542
44.3	1.6464	1.6464
100	8.3979	8.
	~~3.9527~~	3.5548
	~~4.5785~~	4.5785

9.2 per 41.8

74
120

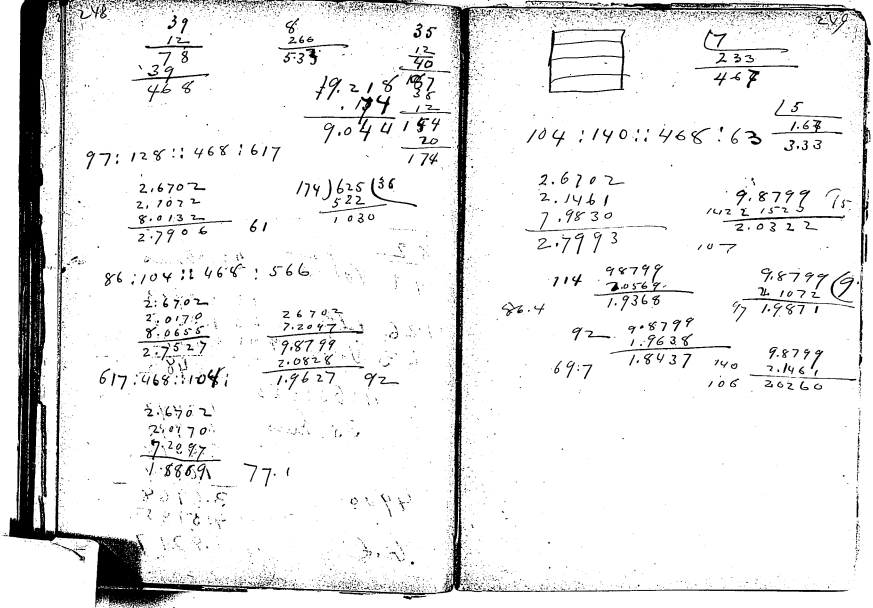
82
41 Volts
126 ~~Volts~~
63 Volts

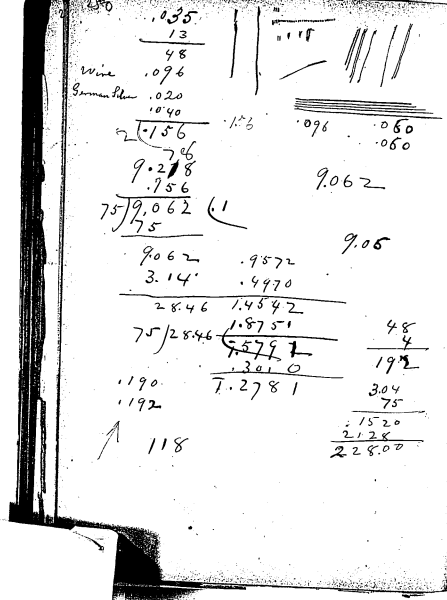
23 Ohms

63	1.7993
23	1.3617
Comp 41	8.3872 - 10
	1.5482

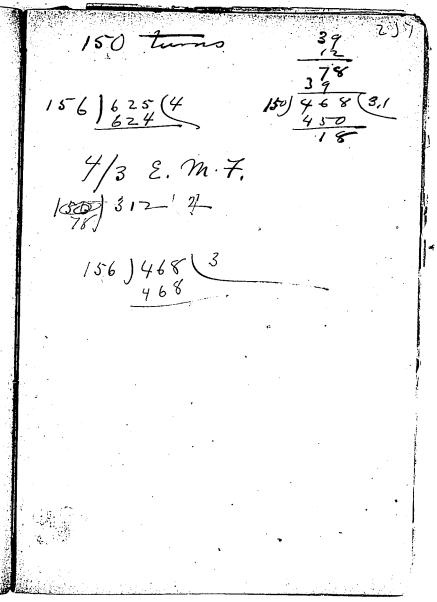
41 : 63 :: 23
35 Ohms

	1.7993
	1.7993
	8.4518
	1.6464
4900	3.6968
6.6	4.5185
	.8217





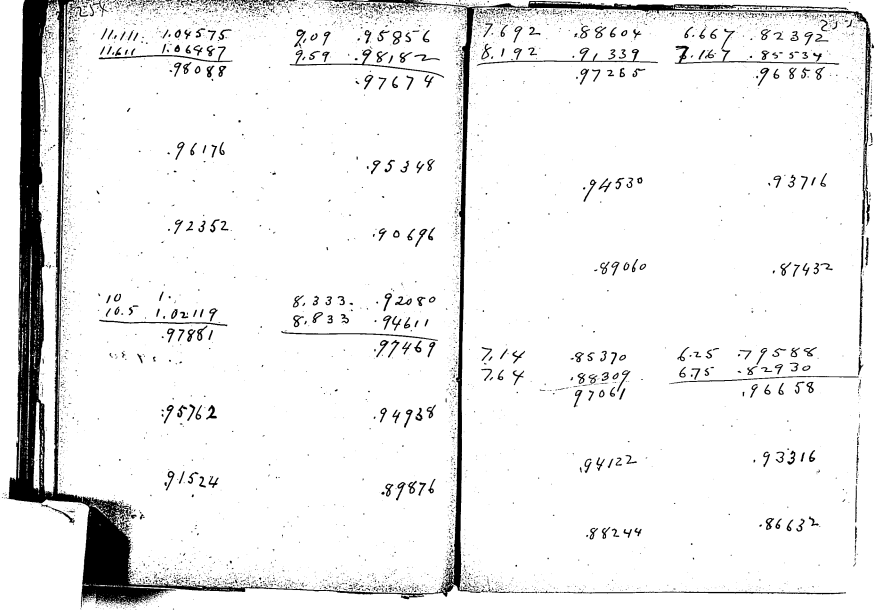
.035
13
48
Wire .096
Gamma Fiber .020
.040
.156
.156
.096
.060
.060
9.278
.756
75 | 9.062 (.1
75
9.062
9.062
3.14
28.46
75 | 28.46
.1190
.1192
118
.9572
.4970
1.4542
1.8751
.3010
1.2781
48
4
192
3.04
75
.1520
2128
228.00



150 turns
156 | 625 (4
624
4/3 E.M.F.
(150) 312 (2
78
156 | 468 | 3
468
39
12
78
39
150 | 4680 (31
450
180
297

100. 2		33.33 1.522784	
100.5 2.00217		33.83 1.52930	
.99783		.99354	
.99566		.98708	
.98132		.99416	
50 1.69897		25 1.39794	
50.5 ~~1.703378~~ 1.703332		25.5 1.406540	
~~.99857~~		.99140	
.99568			
.99136		.98280	
.98272		.96560	

20 1.30103		14.28 1.154734	
20.5 1.31175		14.78 1.169674	
.98928		.98506	
.97856		.97012	
.95712		.94024	
16.67 1.22194		12.5 1.096910	
17.17 1.23477		13. 1.113943	
.98717		.98297	
.97434		.96594	
.94868		.93188	



11.111 1.04575
11.611 1.06787
.98088

.96176

.92352

10 1.
10.5 1.02119
.97881

.95762

.91524

9.09 .95856
9.59 .98182
.97674

.95348

.90696

8.333 .92080
8.833 .94611
.97469

.94988

.89876

7.692 .88604
8.192 .91339
.97265

.94530

.89060

7.14 .85370
7.64 .88309
.97061

.94122

.88244

6.667 .82392
7.167 .85534
.96858

.93716

.87432

6.25 .79588
6.75 .82930
.96658

.93316

.86632

5.882	.76953	5.263	.72123
6.382	.80496	5.763	.76065
	7.96457		.96058
	7.92914		.92116
	7.85828		.84232
5.555	.74468	5.5	.69897
6.055	.78211	6.5	.74036
	.96257		.95861
	.92514		.91722
	.85028		.83444

1250
88
10000
3750
47.500

47.500 Campus
22.500 Border
68000

1500
15
7500
1500
22500

115
1.4
460
115
161

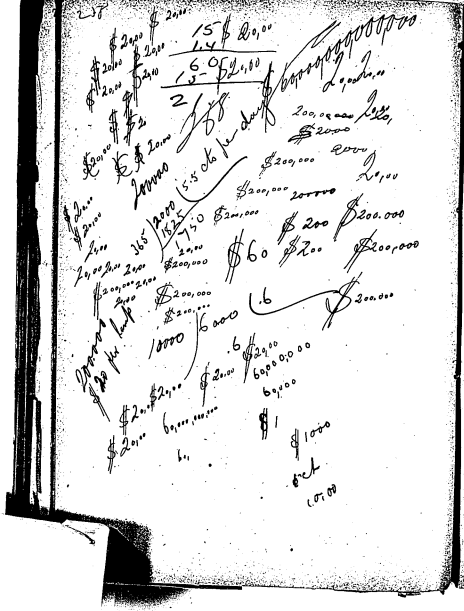
143
1500
715000
143
2145.

84) 1000 (17
84
160
84
76

1000 8400 8.4

Conductor 50 50

50000 Dynamo
68
118000
20000
138000
12000 Armature Lead
126000
12000
114000
28000 164.500



1.65

.37

.40 Machine Conductor

50 100 ohm lamps

2 Ohms

$\frac{4.4}{2}$ $\frac{2}{2.4} = \frac{5}{1.2}$

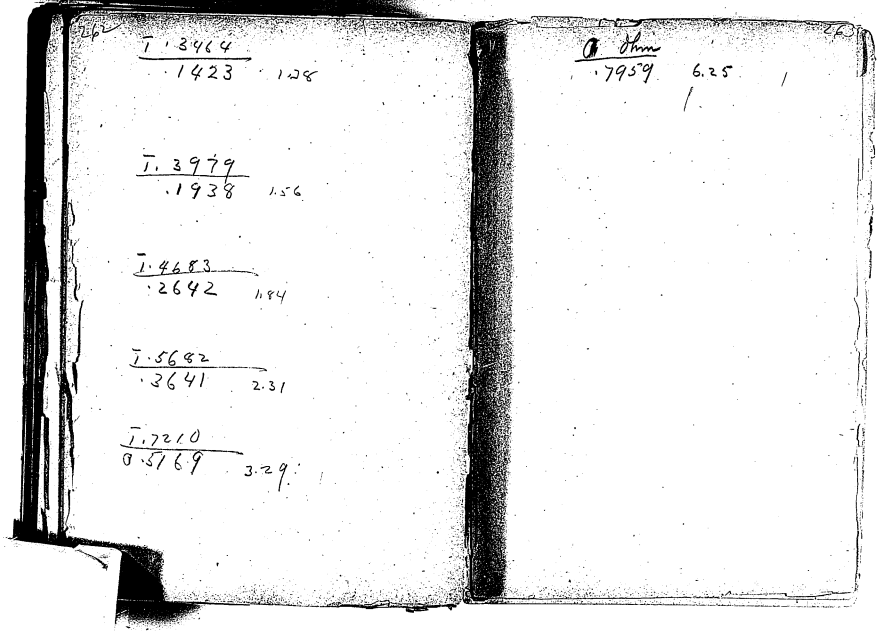
$\frac{1}{1.44}$

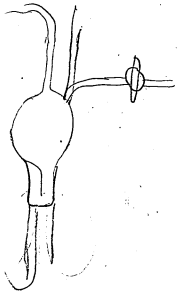
1.44
1.44
576

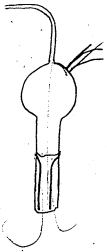
About $\frac{1}{2}$ the light 576
144
2073 6

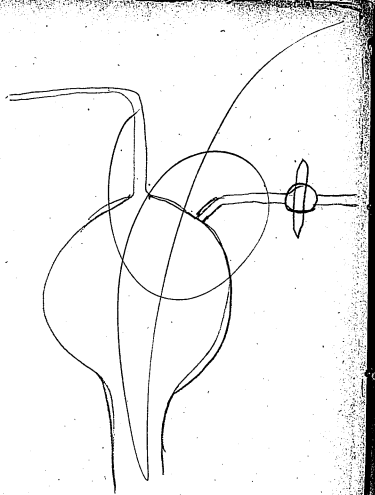
1	.9916 / 3.5801	.9832 / 1.1872
	3238	15.4
2	98.40 / 3.5025	.9680 / .1721
	3180	1487
3	.9770 / 3.4955	.9540 / 1.1581
	3130	14.4
4	~~.9420~~ .9710 / 3.4895	~~.8870~~ .9420 / 1.1461
	3046	14.
5	.9658 / 3.4843	.9316 / 1.1357
	3050	13.6

6	.9614 / 3.4799	.9228 / 1.1269
	3020	13.4
7	.9580 / 3.4765	.9160 / 1.1201
	2997	13.2
8	.9554 / 3.4739	.9108 / 1.1149
	2978	13.
9	.9538 / 3.4723	.9076 / 1.1117
	2964	.13
10	.9530 / 3.4715	.9060 / 1.1101
	2961	12.9


$\bar{I}$ · 3464
· 1423 · 108
$\bar{I}$ · 3979
· 1938 1.56
$\bar{I}$ · 4683
· 2642 1.84
$\bar{I}$ · 5682
· 3641 2.31
$\bar{I}$ · 7210
0 · 5769 3.29
Ohm
· 7959 6.25







9 cells

18 Volts

4.3 ohms

Say 9 Volts on 2 Ohms

~~So~~

2/81

40.5

44.3

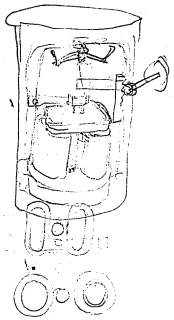
40.5

2215

176.2

1784.1.5

July 24. 1879



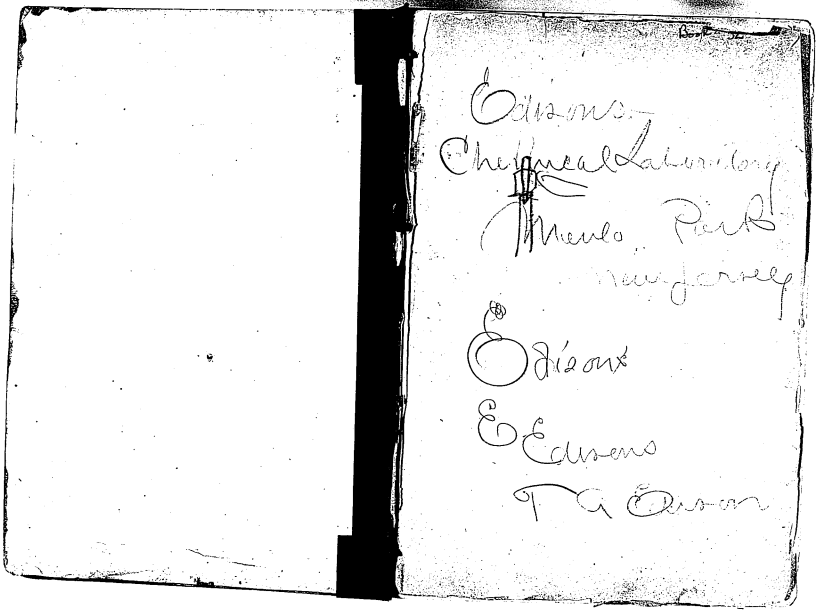
Menlo Park Notebook #32 [N-79-03-10.2]

This notebook covers the period March 1879-July 1880. Most of the entries are by C. E. Mumsell and John W. Lawson. There are also entries by Edison, Charles Batchelor, and Francis Upton. The material by Mumsell consists of notes on lampblack and sulphide experiments. The notes by Lawson relate to experiments on woods for lamp filaments, chalk experiments conducted with Batchelor, and miscellaneous chemical experiments. The material by Edison includes notes on carbon filaments, calculations about electric power distribution, and lists of metal alloys. There are also miscellaneous calculations by Upton and others. The label on the front cover is marked "Woods ect." There are 282 pages numbered back to front, and the book has been used in both directions.

Filming order: pp. 1-231; pp. 282-236 [in reverse page-number order].

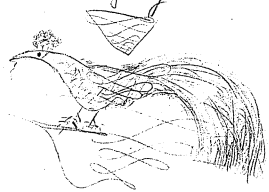
Blank pages not filmed: 4-7, 50-51, 56-57, 80-89, 104-107, 132-139, 142-149, 152-187, 190-207, 210-219, 222-227, 232-235, 242-249, 264-265, 272-273.

Missing page numbers: 121-122, 237-240.


Edisons
Chemical Laboratory
Menlo Park
New Jersey
Edison
Edisons
To Edison

Edisons

T. A. Edison
Menlo Park
New Jersey



Lampblack.
March 10 – 14th 1879
C E Mumsell.

10.

Index.

Page 11. Heat alone.
" 12. Those made in too small quantity to test.
" 13. Qualitative Analysis.
" 14. Weighings.
" 15. Resistances of Buttons.
" 16. Sist of Bottles.
" 17. Bromine.
" 18. Alcohol.
" 19. Iodine.
" 20. Chromic acid.
" 21. Chlorate of Potassium.
" 22. Carbon Bi-sulphide.
" 23. Potassic Bi-Chromate.
Bleaching Powder.

Lampblack. Heat alone. 11.

1. Extra Eddy's Son's

Heated in Hessian Crucible for 30 minutes at a red heat in coke fire in furnace) the crucible being lined with plaster of Paris, which scaled off by the heat allowing access to the air; Cooled and sieved through 40# sieve. Buttons from this moulded all right, but were too brown. Buttons No. 1. Resistance = 3600 ohms

2.

Heated in Hessian crucible for 1 hour at a red heat in Coke fire in furnace; the crucible being lined with fire clay & sand which acted properly; Cooled & sieved through 40# sieve. Moulded all right; buttons too brown. Buttons No. 2.

3.

Heated in a Hessian crucible for 2 hours, at a red heat in coke fire in furnace; the crucible being lined with fire clay (2 parts) and sand (1 part), which did not crack; Cooled & sieved through 40# sieve.

Small Bottles.

1. 14 parts 10 grms Lampblack
   1 " " KCl
   28 " 20 c.c. Conc. H_2SO_4
   Heated on sand bath for 4 hours, ℔ 10 minutes in Crucible furnace, pulverized ℔ sieved through 40# sieve.
   Hard button which would not mouse.
2. Kerosene Carbon.
3. 1 grm Lampblack
   .3 " KNO_3
   Heated in porcelain crucible for 15 minutes, washed with H_2O & dried.
4. .9 grms Lampblack
   50 c.c. Conc. HCl
   20 " " HNO_3
   Boiled for 6 hours in beaker on sand bath, washed & dried.
5. See Cooth & Morfit, Ency. of chem.
   .5 grms Lampblack
   10 c.c. Alcohol
   20 c.c. NaOH solution
   20 c.c. H_2O_2
   Lampblack digested in beaker with alcohol for 1 hour, filtered, washed on filter with Na OH solution, and then with H_2O, dried in steam bath.
6. 2.5 grms Lampblack
   5 c.c. Conc. HNO_3
   10 " " H_2SO_4
   Heated for 6 hours in porcelain dish on sand bath, dried until all the H_2SO_4 was expelled, pulverized and sieved through 40# sieve.
7. 2 grms Lampblack
   5 c.c. HNO_3 conc.
   5 " H_2SO_4 "
   Heated in porcelain dish on sand bath for 4 hours, washed, filtered, washed & dried.

C, N, Fe,

Books Consulted.

Watt's Dictionary. Vol. 1. P. 759.
Gmelin's Handbook. " 2. " 83.

Lampblack.

Watch glass + lampblack	19.1740
" " "	18.2706
" " " $HCl + HNO_3$	.9034
Watch glass + Lampblack	23.6046
" " "	18.2706
" " " Rx.	4.3340
Watch glass + lampblack "	18.6516
" " " HCl.	18.2706
Carbon button + Watch glass "	.3810
" " " "	18.5756
" "	18.2706
	.3050

Lampblack Buttons.

1.	Kerosene Carbon.						Resistance = 60 ohms
2.	From	1	Page	11.			" = 360 "
3.	"	2	"	"			
4.	"	1	by	Rx.	Page	17.	Resist. 730 Ohms
5.	"	1	"	9.	"	19.	" 870 "
6.	"	2	"	Rx	"	17.	
7.	"	2	"	9	"	19.	
8.	"	2	"	CS_2	"	22.	Resist. 1.02
9.	"	3	"	CS_2	"	22.	" = .

16

Large Bottles.

1. No. 1. Page 11.
2. " 2. " 11.
3. " 1. " 17.
4. " 2. " 17.
5. " 1. " 19.
6. " 2. " 19.
7. " 1. " 20.
8. " 1. " 21.
9. " 2. " 21.
10. " 3. " 11.
11. " 1. " 22.
12. " 1. " 23.
13. " 3. " 23.
14. " 1. " 15.
15. " 2. " 22.
16. " 2. " 23.

Sampblack. Br. 1

Sampblack 4.3 grms
Br 4 C.C.
2 C.C.

Sampblack digested with Br in the cold for 16 hours, then with 2.C.C. more of Br., then heated on sand bath, and sieved through 40 ☒ sieve. Buttons from this moulded all right, but resistance too high - 930 Ohms, and too brown in color.

2

Calcined Sampblack 2 grms
Bromine 2 C.C.

Digested in cold for 1 hour, then heated on sand bath for 1 hour. Buttons easily moulded, but brittle and too brown. Resistance = Ohms.

18. C_2H_6O. No. 14.

Lampblack	5 grms.
C_2H_6O	50 c.c.
$(C_2H_5)_2O$	50 "
NaOH solution	60 "
HCl dilute	50 "
HNO_3 "	20 "

Filtered, washed & dried after each operation; sieved through 40# sieve.

Lampblack. 2. No. 5. 19.

Lampblack 3 grms
Iodine 1 "
Heated in porcelain dish for 2 hours on sand bath until all the I was expelled. Sieved through 40# sieve; moulded all right, but buttons were of a brownish black color, with a resistance of 870 Ohms.

2. No. 6.

Calcined lampblack 2 grms
Iodine 1 "
Heated in porcelain dish on sand bath for 2 hours & sieved through 40# sieve. Buttons easily moulded but broke with facility. Resistance = Ohms.

20. 1 $CrCl_3$.

Sampblack	3 grms
$CrCl_3$	1 "
H_2SO_4 conc.	5 C.C.

Heated in porcelain dish on sand bath for 1 hour, washed, filtered, washed & dried.

K_2ClO_3 21.

1.

Sampblack	4 grms
$KClO_3$	.3 "
H_2SO_4 conc.	10 C.C.

Heated in porcelain dish on sand bath for 3 hours, or until all the H_2SO_4 was expelled; washed, filtered, washed, and dried.

2.

Sampblack	5 grms
$KClO_3$	.4 "
H_2SO_4 conc.	8 C.C.

Heated for 2 hours in steam chest, & for 3 hours on sand bath, washed, filtered, washed, & dried.

22

CS_2. No. 11.

Lampblack (Calcined P. 11. #3) 2 grms
CS_2 100 c.c.

Digested for 1 hour in steam chest; washed with 50 c.c. of CS_2, filtered, washed with 30 c.c. of CS_2, then with 50 c.c. of $(C_2H_5)_2O$; dried, heated on sand bath in porcelain dish, sieved through 40# sieve, and reheated.

Buttons mould well, ~~could~~ give very small resistance, 1.02 to .94 ohms without pressure, but .31 ohms under pressure, hence not sensitive enough.

Calcined 2 No. 15.

5 grms. Lampblack (No. 1) levigated in 500 c.c. of H_2O, and about 2 grms of the lighter portion taken. This was dried, treated with 50 c.c. of CS_2 in a porcelain dish in steam chest for 30 minutes, washed with 20 c.c. of CS_2, filtered, and washed first with 30 c.c. of CS_2, and then with 20 c.c. of $(C_2H_5)_2O$; dried and heated on sand bath. Sieved through 40# sieve & reheated.

$K_2Cr_2O_7$. No. 12. 23.

Lampblack 2 grms
$K_2Cr_2O_7$ 2 "
H_2SO_4 Conc. 5 c.c.

Heated for 2 hours in porcelain dish on sand bath; washed, filtered, washed, & dried; sieved through 40# sieve.

$CaCl_2$ + $CaCl_2O$. No. 13.
1

Lampblack 2 grms
Bleaching powder 2 "
H_2SO_4 Conc. 10 c.c.

Digested for 2 hours in porcelain dish in cold, then for 2 hours heated on sand bath, washed, filtered, washed, dried, and sieved through 40# sieve.

2. No. 16.

Calcined Lampblack 2 grms
Bleaching Powder 2 "
Conc. HCl 10 c.c.

Digested for 2 hours in a porcelain dish in the cold; then on sand bath for 6 hours; washed, filtered, & washed; first residue thrown away on account of not drying (from $CaCl_2$); filtrate re-filtered through two filters, & residue washed & dried.

Sulphides.

March 15th to April 12th 1879.

O. E. Munsell.

Index of Sulphides

Page		
29.	Aluminium.	Sulphide
29.	Copper.	"
31.	Antimony.	"
33.	Zinc.	"
35.	Bismuth.	"
37 + 39.	Manganese	"
41.	Arsenic	"
42.	Lead	"
43 + 44.	Nickel	"
45.	Tin	"
46.	Iron	"
47.	Cadmium	"
49.	Tungsten	"
51.		
53.	Rose Metal	
55.	Muntz "	
	Bell "	

Sulphide of.

Aluminium	Al_2S_3	Al+S	Too expensive

Cu.

Cu_2S.

Books consulted:—

Roscoe & Schorlemmer's Chemistry. { Vol. II. Pt. I. P. 343.
Watts' Dictionary of " Vol. II. P. 74.

1.

Cu_2S	50 grms
Fused borax	2 "

Would not fuse in plumbago crucible over blast, although heated for 30 minutes: luted with fine clay and sand (2:1) for 35 minutes in Coke fire in furnace: fused well, but spit on casting. No. 1.

2.

Cu_2S	50 grms.

No borax; fused in luted plumbago crucible as before; cast well into bar. No. 2.

Cu_3S.

Cu_2S	50 grms
S	20 "

Ground fine and fused together in Hessian Crucible over blast-lamp for 10 minutes, or until the S. commenced to burn, & cooled. Formed in fine grains which are converted into S. and Cu_2S, when heated above the melting point of S., hence could not be cast.

Cu_2S. 1

Cu_2S 150 grms
Heated for 35 minutes in Hessian Crucible in coke fire. Bar well formed, 78 grms.
Bar broke by falling.

2.

Cu_2S fused (cast bars) 145 grms
" fine (bought) 100 "
Heated for 30 minutes, bar of 110 "

3.

Cu_2S fused 124 grms
" fine 35 "
Heated for 30 minutes, bar oxidized on surface from mould being too damp.

Sb^2S^3.

Books Consulted: —
Watts' Dictionary. Vol. 1. P. 329.

1.

Sb_2S_3 50 grms.
Heated for 10 minutes in Hessian Crucible luted (fire clay & sand) in Coke fire, but did not fuse.

2.

Sb_2S_3 50 grms
Heated as before in Graphite Crucible for 20 minutes, but no fusion: Cooled 20 grms. of Sb_2S_3 added, deluted, and fused for 30 minutes.

3.

200 grms of Sb_2S_3 in fused pieces which were prepared by repeated recastings, were cast into a bar.

Books Consulted:—

Roscoe & Schorlemmer's Vol. II. Pt. I. P. 263.
Watts' Dictionary " V. " 1074.

1.

Granulated Zn	50 grms
Ground roll S	20 "

Heated in Luted Pipe Clay + sand) Hessian Crucible in coke fire (very hot) in furnace for 90 minutes: result a failure, the lute broke and allowed the S. to vaporise, the Zn nearly all vaporized except a small quantity which oxidized, and the ZnO attacked the crucible forming a brownish gray slag, which cooled quickly.

2.

Granulated Zn	100 grms
H_2SO_4 Conc.	400 c.c.
H_2O	1000 "

Zn dissolved in $H_2SO_4 + H_2O$, first in the cold and afterwards by heat: filtered from C. and other impurities, H_2SO_4 neutralized with Na_2CO_3 and $NaC_2H_3O_2$, forming an $HC_2H_3O_2$ solution through which H_2S was passed. Zn S filtered out + dried. 50 grms of Zn S heated in Graphite Crucible for 30 minutes but lute broke so that the Zn nearly all volatized, that which remained formed a dark green crust.

84.

2.

Zn S (prepared as before) ... grms

Watts' Vol. I. P. 595. Bi^2S^3.

85.

Bismuth (ground fine) 40 mesh 60 grms
Sulphur " " 20 "

Heated for 20 minutes in Hessian crucible, but the lute broke and nearly all volatilized.

2.

Bismuth (ground fine, 40 mesh) 60 grms
Sulphur " " 20 "

~~After~~ heating this as before, ~~three~~ following were added:

Bismuth 90 grms
Sulphur 40 "

~~These~~ were heated in a ~~Hessian~~ Hessian crucible with a graphite cover, luted well, but blew up. On heating again with a Hessian cover for 20 minutes in coal fire, Bi^2S^3 was formed, but did not fuse; of this 123 grms were taken and heated as before for 15 minutes forming a small bar and some scraps which weighed altogether 114 grms: this formed a bar weighing 79 grms.

Mn S. 1

37

MnO_2 (natural)	100 grms
H_2SO_4 Conc.	400 C.C.
H_2O	1000 "

Heated together in beaker on sand bath for 14 hours, then transferred to large porcelain (iron) evaporating dish for 10 hours; then taken up with H_2O, and filtered, neutralized with $NaHCO_3$; $Na_2C_2H_2O_2$ added, and precipitate of $Fe_3(OH)_6$ filtered out; NH_4OH & $(NH_4)_2S$ added;

2.

MnO_2 (artificial)	50 grms
$H_2C_2O_4$	5 "
H_2SO_4 Conc.	100 C.C.
H_2O	200 "

1.

MnO_2 (natural) 50 grms
S 20 "

Heated for 30 minutes in Hessian Crucible (luted with pipe clay + sand) in coal fire in furnace; fused well but the bar was entirely composed of air bubbles; bar consisted of Mn SiO3, Silicon from the crucible.

2.

MnO_2 (natural) 50 grms
S 20 "

Heated in graphite crucible, luted with fire clay and sand, in coal fire for 1,00 hours: lower potation semi-fused, upppart a brown powder consisting of Mn S and some $Mn SO_4$. Imperfect fusion due to MnO_2 being too impure.

3.

MnO_2 (artificial) 50 grms
S 20 "

Heated in Hessian crucible

A

A S_2 S_2

A S_2 S_2 100 grms
Heated in Into Hessian Crucible in Coke fire for

PbS.

1

Powdered PbS 87 grms
Mixed PbS 193 grms
Heated in Hessian crucible for 15 minutes in coal fire; gave bar of 134 grms which broke up into several pieces. This bar heated with scraps of mixed PbS, 191 grms in all, for 30 minutes gave fine bar of 141 grms, but had an air-hole on top.

2

Powdered PbS 105 grms
Mixed " 55 "
Heated for 30 minutes in Hessian crucible in coal fire gave good bar.

Ni_2S.

Watt's, Vol. IV, P. 42.

Ni in grains 50 grms
HNO_3 conc. 200 C.C.

Heated in beaker on sand bath until all the Ni was dissolved, then evaporated nearly till the $Ni(NO_3)_2$ crystallized on cooling; reheated until crystals redissolved and 50 C.C. of H_2SO_4 added, then evaporated to dryness in porcelain dish; and sieved through 40 sieve. Then $NiSO_4$ 60 grms were mixed 11 grms of lampblack and heated in a luted Hessian crucible for 1 hour. formed bar full of air bubbles.

Ni S.

Ni 50 grms
HNO_3 conc. 200 C.C.

Ni treated with HNO_3 until brought into solution, then evaporated to dryness, and ignited so as to convert the $Ni(NO_3)_2$ into NiO, which was sieved through 4 mesh.

Sn S.

1.

Sn Rolled & Cut fine 150 grms
S 60 "
Heated in Graphite Crucible in Coke fire, Cover blow off, and S. burnt.

2.

Sn rolled & Cut fine 200 grms
S 80 "
Sn S fused 23 "
Heated for 30 minutes in graphite Crucible in Coal fire, but did not run well into mould on account of the holes being stopped. 386 grms of this fused SnS reheated, formed very fine bars.

Fe S

Fe S (refused) 65 grms.
Fe S (bought) 135 "
Heated for 30 minutes in graphite crucible in coal fire; bar but a shell.
200 grms. mixed Fe S formed one bar of 90 grms; the other was too small and therefore was remelted forming a good 105 grm bar. (with most Fe S)

Cd S.

Watts', Vol. 1., P. 706.

Cd 24 grms.
HNO_3 Conc. 150 C.C.
HCl " 50 C.C.

Cd heated in beaker with 50 C.C. of HCl, but dissolved very slowly, for 1 hour; Then HCl solution decanted off and 50 C.C. of Conc. HNO_3 added to bars of Cd, which dissolved them rapidly; the HNO_3 solution was then evaporated to small bulk, and the HCl solution added, then boiled to expel HNO_3, and then evaporated to dryness: $CdCl_2$ taken up with H_2O, and diluted to 300 C.C. through which H_2S gas was passed for 2 hours; CdS filtered and washed, H_2S being passed through filtrate and the Cd not precipitated. The first time recovered; both ppts of CdS dried,

WS².

Books consulted :—
'Watts' Dictionary. Vol. V., P. 914.

Prep. of Acid Sodic Tungstate :—
50 grms of Na_2WO_4 where heated in beaker with 100 c.c HNO_3) filtered, washed and dried; the WO_3 produced was added to a solution of 100 grms Na_2WO_4 in 200 c.c. of H_2O, and the whole evaporated to dryness producing $3Na_2O, 7WO_3$.

Rose Metal.

Gmelin. Vol. V. Page 180.

Bismuth	2 Parts
Lead	1 "
Tin	1 "

Melts at 93.75°C.

Muntz Metal.

		Mott.	
Cu	60 parts	240	grms
Zn	40 "	160	"

The Cu was heated in graphite crucible for 20 minutes, then taken out, stirred, and Zn added about 10 grms at a time; then stirred, and put back for 5 minutes into fire; then taken out and poured: bar weighed 172 grms; not enough for second bar.

~~Bell Metal~~

2. Mesquet.

Cu	56 pts	224 grms
Zn	40.75 "	163 "
Pb	4.50 "	18 "
	101.25	405 "

Cu was heated in graphite crucible for 20 minutes, then taken out, stirred, and Zn added; put back for 5 minutes and Pb added; then reheated & cast. Bars of 176 & 197 grms.

Bell Metal.

Cu	69 %	276 grms
Sn	31 %	124 "

Cu heated in graphite crucible in coal fire until melted; then taken out of furnace and Sn added; then put back for 5 minutes and then cast. Bars of a white color and brittle; weighing 177 and 196 grms.

Cu 78 %
Sn 22 %

2.

Lawson.

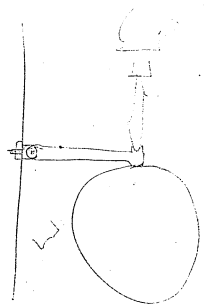
L. W. Lawson

May 23/79

Cerium Oxalate

Heated to drive off H_2O and CO_2 — Dissolved oxide in HCl — Evaporated and dissolved in H_2O; residue SiO_2 —

H_2S, Precip. Black — contains Bi, In or Cd — minute quantities



Make

3ß Pp chalk
100 gn Hg Acet.
1 ß Caustic Na

3ß Pp Chalk
100 gn Hg Acet
1ß Caustic K

6ß Chalk
Chloride Lithia 1 pint ß
18 gn Hg Acet.

Chalk 6 B
Caustic Soda 1/Flask B.
Hot water Syringy with
gelatine

3 ℥ Chalk
90 ℳ Hg Acet
1 ℔ Aq

6

61 ℥. Chalk
180 ℳ. Hg Acet

36

12 [redacted] By Check
1 5 qts Asst
2 gt (Plus) [illegible]

Hand lift and make bellows to
just blow pressure [illegible]
K.

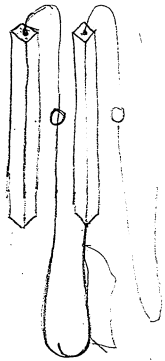
Lawson

Make a Saturated Solution of Caustic Soda & mix ¼ its weight Chalk and dip cotton

Make a Saturated Solution of Caustic Soda Mix ½ weight

Make Saturated Solution Caustic Soda

Make a button of fused
Caustic Soda +
Caustic K



12

Lawson June 9th 1919 13

Have Sequeira help you and make the following:-

1 Make Saturated Solution of Caustic Na and mix ¼ th. weight of Chalk dry out and make Button with good pressure (2 Buttons) Another ~~½ weight~~

2 Ditto with Caustic Ks Another ½ weight (2 buttons)

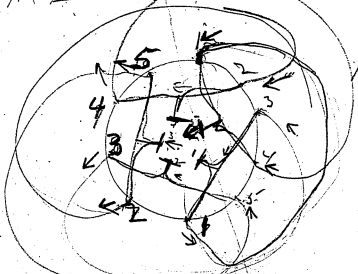
3 In a sat. Sol. of Caustic Na add as much Chalk as make thick paste Then fr weight of (each Button add of Brown Hay 2 Buttons

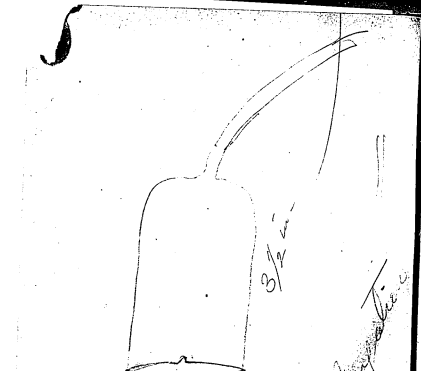
4 Ditto with Caustic Ks

5 Make 1 button of fused Caustic Na

6 Sticks of fused Caustic KI

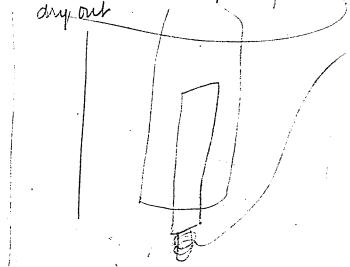
3 chalk
9 acel. Hg
1 Mn





Sat Sol of Na C dried out by evaporation and then mixed in equal proportion dry with regular Britton's

Would one without ~~pan~~ Sifting and dry out



47 1.6721
Comp 2 35 7.6289
Comp 3 9.5229
8.8239
62 1.792 4
.6153

97 1.9868
8.8239
.8107

115 2.0607
8.8239
.8816

131 2.1173
8.8239
.9912

162 2.2095
8.8239
1.0334

178 2.2504
8.8239
1.0743

228 2.3579
8.8239
1.1818

280 2.4472
8.8239
1.2711

Experiments by Brand
on Carbonyd Transmissant
Combinations. June 12 1880.

Cotton Cloth carbonyzed nicely
but cannot use such cloth
fine enough in meaning to
make narrow enough slots.

Flour paper makes a
very light + puffy but when
carbonized it crumbles too much

Gum Tragacanth works nicely
think it will go as a Carbonized
well + don't require so much
good Lagacanth + they are

Jany 12. 1863

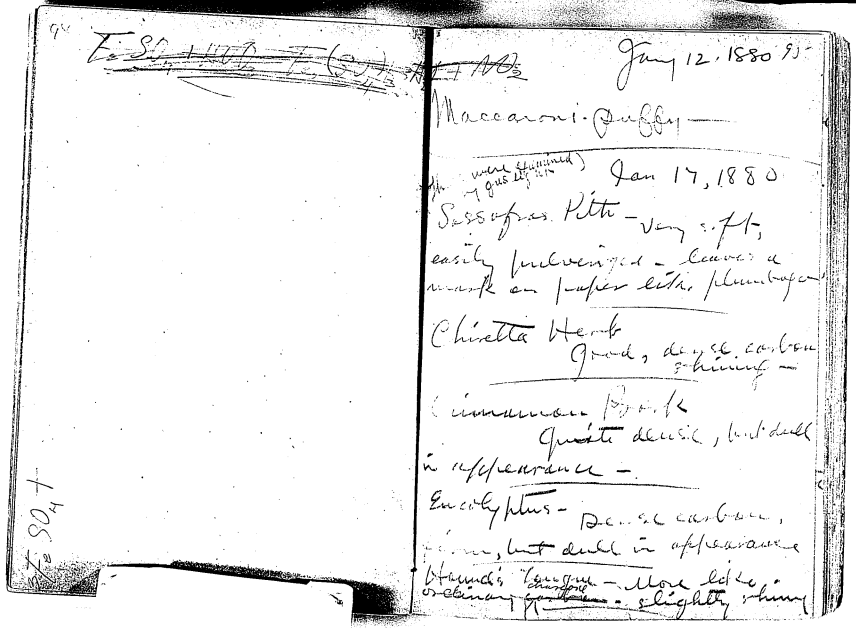
Asphaltum.
Very brittle but succeeding
Gives much Carbon in smoke.

Gum Myrrh - gives much carbon
& light weight —

Gum Kino — [illegible] —

Gum Copal gives thin brittle
very shining Carbon like
asphaltum

Leather Carbon not much
light —



Jan. 17, 1880

Swamp Huckleberry - Does not seem to be well carbonized - Surface glittens in gaslight -

Buckbean Root - Dull, porous -

Poppy Caps - Shining, vesicular, surface not honeycombed, however -

Rosin Weed - Shining, fibrous; not well carbonized -

High Elder Berry - Firm, fracture shining -

Indian Tobacco - Puffy -

Jan, 17, 1880 — 99

White Wood Bark — Firm, fracture shining.

Indian Violet — Very powdery, not having a high lustre —

Pennsylvania Peat — Carbon dense, fracture shining —

Augustine Bark — Porous and dull —

Yellow Jaccaranda — Carbon dense, fracture slightly dull —

Pareira Brava — Not so dense as preceding —

Jan. 17, 1880 101

Ginger Root -
Bulb and leaves -

Peruvy Root -
Bulb, friable.

Sweet Birch Bark -
Dense, slightly shining -

Cassia Root - Leaves -

Jan. 18, 1880

Black Weed
Carbonized very much,
silky lustre -

Sugar Puffy, shining

Black Sugar Puffy, shining

Clinton River

Downey, Anderson

Cook Pontiac, Auld

Pipelon Brook Franklin

April 9- 1880 -

Experiments began today for the purpose of removing gums, resins, ect- from the various kinds of woods

All foreign substances to be removed leaving nothing but the cellular structure of the wood -

Small pieces of the different kinds of wood 1 or 2 in. square and 1/16 in. thick are first weighed in air then placed in alcohol and allowed to remain until all matter soluble in alcohol has been removed - They are then placed in ether until all matter soluble in ether has been removed, next are treated with aqua ammonia, hydrochloric acid, well washed

in water and subjected
to the action of chlorine gas

Woods placed in alcohol—
Weight before
Wt. = weight—

	Grms.
Muga ~~(illegible)~~	.8935
Tiger	.9077
Rose	1.1477
Tulip	.943
Mahogany	.8815
Lignabola	1.6526
Turtle	1.4642
Amaranth	1.274
San Domingo Mahogany	1.1895
White Pine	.778
Orange	.3649
Sassafras	.4476
Milli Wood	1.218
Dogwood	.750

Ebony	2.3865
White Thorn	1.2925
Apple	1.918
Black Walnut	1.731
Oak	1.469

April 13-80

Woods, ~~reduced~~ from alcohol and placed in ether

From:-	Color of alcoholic extract
Thuya	Light; transparent brown
Tiger	" greenish brown
Rose	Dark, opaque brown
Tulip	Light; transparent rose
Mahogany	Similar to Tiger but much fuller
Canebrake	Deep red
Turtle XX	Similar to Rose but much fuller
Amaranth	Magenta
San Domingo Mahogany	Similar to Mahogany but darker
White Pine	Colorless
Orange	"

Ebony placed in nitric acid:- alcoholic and ether seem to have but little action on the coloring matter. Nitric acid extracts the coloring matter from ebony wood without injuring its tissue."

Gmelin IX- 160

This was tried using ebony wood but the strength of the wood was completely destroyed; perhaps the acid used was too conc., dilute might give better results.

Specimen	Color
Mahi Wood	Dingy, barely perceptible
Dogwood	Colorless
Ebony	Dingy, barely perceptible
White Thorn	" " "
Apple	" " "
Black Walnut	Very pale umber
Oak	Colorless

April 19-

Removed from ether and placed in agua ammonia

Color of the etheric extract from eagle wood similar to that of the alcoholic extract.

April 25-

Removed from agua ammonia well washed in water and placed in dilute hydrochloric acid-

Color of the ammonias extract similar to that of the alcoholic

116

348

480 | 26.4 | 348
212
195
792
480 | 1904 | 160
1488
288

117

May 4

Removed from ~~this~~ Hcl solution and washed in water

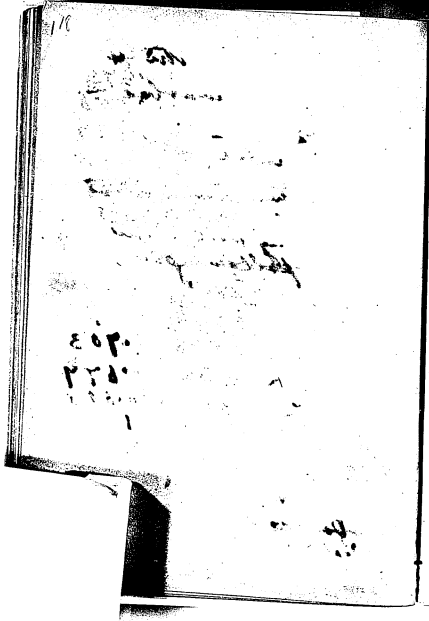
May 12

Treated with Cl gas, and washed in water

May 25

After being well dried they gave the following weights:

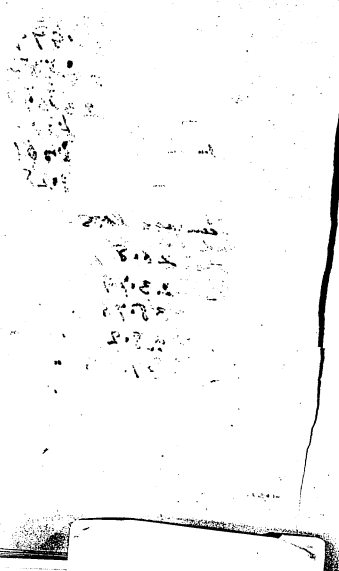
Hunga	.654
Ligia	.692
Rose	.703
Lilly	.677
Mahogany	.608
Canabola	1.224
Turtle	1.147
Amaranth	.840
San Domingo Mahogany	.828
White Pine	.674
Orange	.256



Sassafras	.361
White Wood	.979
Dogwood	.958
White Thorn	.979
Apple	1.465
Black Walnut	1.461
Oak	1.281

Percentage loss.

Hunga	—	26.8
Tiger	—	23.79 "
Rose	—	38.76 "
Tulip	—	28.2 "
Mehogeny	—	31.06 "
Cwabola	—	25.9 "
Turtle	—	21.65 "
Amaranth	—	30.14 "
San Domingo Mahogany	—	30.42 "
White Pine	—	13.37 "
Orange	—	29.86 "



Sassafras	—	19·42 %
White Wood	—	19·62 "
Dogwood	—	25·6 "
White Thorn	—	24·28 "
Apple	—	23·61 "
Black Walnut	—	15·6 "
Oak	—	12·8 "

May 26

Reweighed the woods, after allowing them to remain exposed to the atmosphere since the former weighing

Hunga	—	·0075 %	gain in weight
Light	—	·0058 "	" "
Rose	—	·0056 "	" "
Tulip	—	·0103 "	" "
Mahogany	—	·0024 "	loss "
Canabolk	—	·0212 "	gain "
Cuitta	—	·0165 "	" "
Swamutta	—	·0190 "	" "

San Domingo Mahogany	—	.0000	Again — weight
White Pine	—	.0013	" " "
Orange	—	.0059	" loss "
Sassafras	—	.0028	" " "
White wood	—	.0122	" gain "
Dogwood	—	.0000	" " "
White Thorn	—	.0102	" " "
Apple	—	.0150	" " "
Black Walnut	—	.0123	" " "
Oak	—	.0109	" " "

May 27

Reweighed the woods again today

Lejon	—	.0043	% loss — Wt.
Rose	—	.0014	" gain "
Cucabola	—	.0040	" " "
Amaranth	—	.0022	" " "
San Domingo Mahogany	—	.0024	" loss "
White Pine	—	.0029	" " "

Apple — .0060 % gain = Ans.
Black Walnut — .0033 " " "
Oak — .0030 " " "

In the weights of the others there was no difference —

Placed in alcohol today the following woods:

	Wt.
Fustic	.989
Bay	.6695
White Holly	.6315
Hemlock	.975
Spruce	.894
Gum wood	.4404
Ash	1.265
Lignum Vitae	2.632
Box	.9285
Mora	1.388
Cherry	.735
Maple	1.367
Camphor	.946

Bird's Eye Maple	.946
Yellow Pine	1.1375
Red Cedar	1.0215
Satin	1.710
Cabora	2.807

June 7

Removed the alcohol and placed in ether

	Color of the alcoholic extract
Fustic	Fine Yellow
Bay	Darker "
White Holly	Colorless
Hemlock	"
Spruce	"
Gum wood	"
Ash	
Lignum Vitae	Dirty Yellow
Bass	Colorless
Mora	Umber

Cherry	Colorless
Maple	"
Camphor	slightly colored
Bird's Eye Maple	"
Yellow Pine	
Red Cedar	Light Pink
Satin	Colorless
Cocoa	Light Brown

June 15-
Removed from ether and placed in aqua ammonia

June 23-
Removed from the aqua ammonia and well washed in water -

June 26
Placed in dilute HCl

July 1
Removed from HCl and treated with water -

June 17

Placed 100 grams finely cut Bast fibre in 2 litres alcohol

June 28

Removed alcoholic extract from fibre, submitted to distillation, concentrated to 300 c.c, evaporated to dryness over steam bath and weighed residue —

Weight of gum ext. extracted by means of alcohol

1.5-5-6 grams

% by weight 1.5-5-6

The fibres which had been treated with alcohol were placed in 2 litres sulphuric ether today

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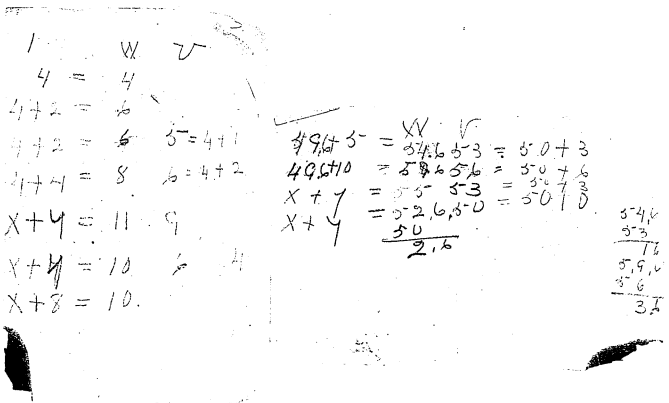

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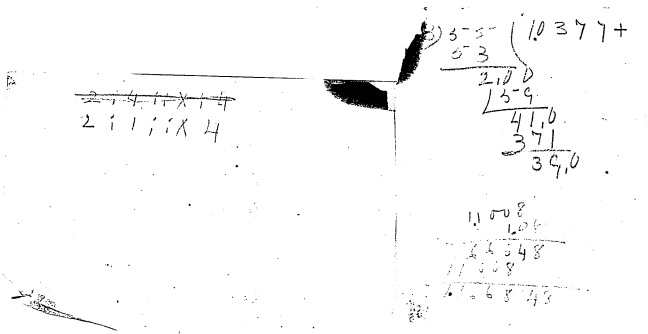


5-/600

5-/1000/=

5

25

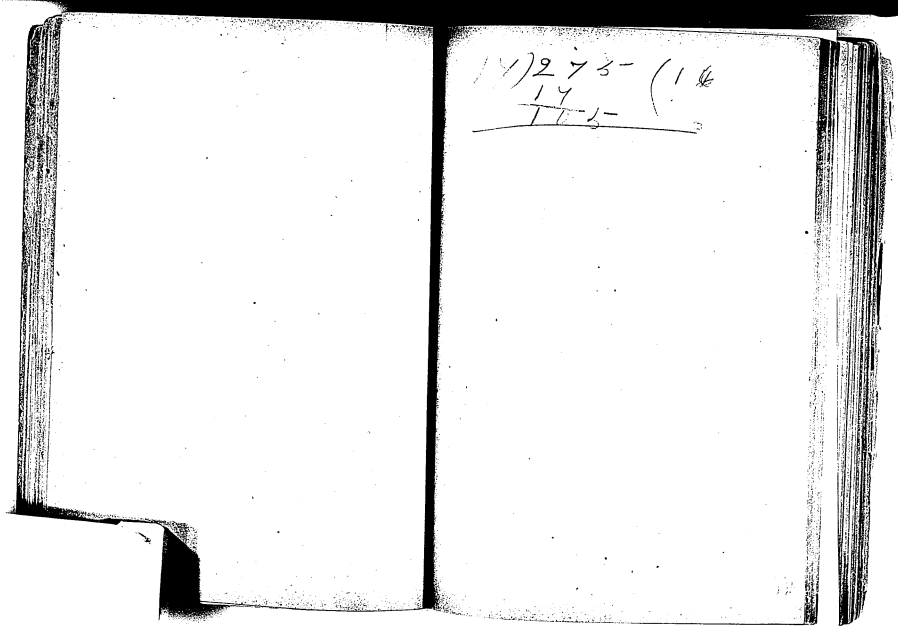
10

40

$\frac{5}{200}$ $= \frac{1}{4}$

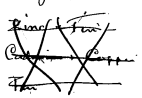
10

500.



Copper	90	Zinc	10
Copper	80	Zinc	20
"	70	"	30
"	60	"	40
"	50	"	50
"	40	"	60
"	30	"	70
"	20	"	80
"	10	"	90

Varying as above.



Copper + Iron
" " Lead
" " Cadmium
" " Antimony
" " Arsenic
" "

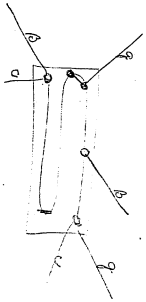
Zinc + Iron
" Lead
" Cadmium
" Antimony
" Arsenic

Iron + Lead
" Cadmium
" Antimony
" Arsenic

Lead + Cadmium
" " Antimony
Arsenic

Cadmium + Antimony
" Arsenic

Antimony + Arsenic

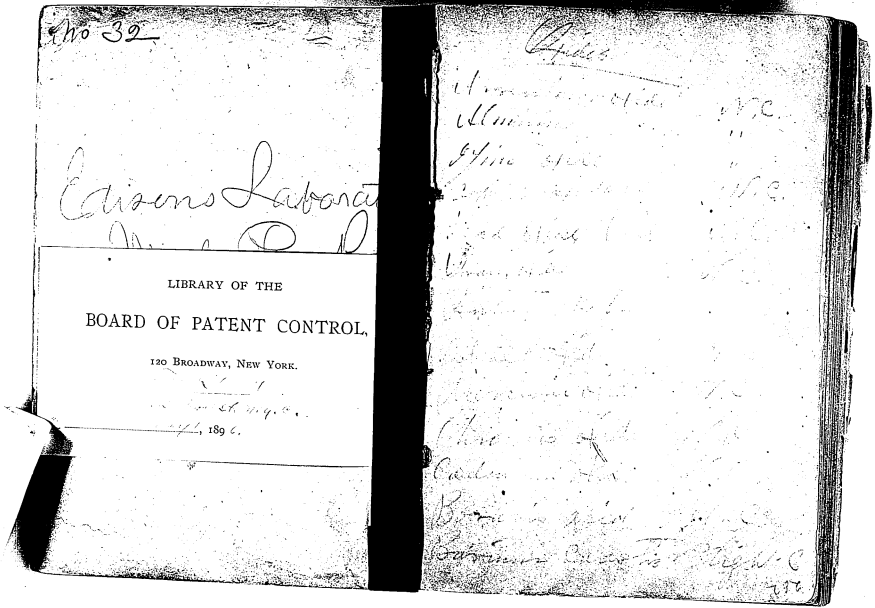


½ Size at 16 candles (Candle)
75 hours; Res 79 ~~8~~ 80
ohms 13.2 per hp

at 8½ candles 82 • 3 -

No 32

Edisons Laborat
Menlo Park
New Jers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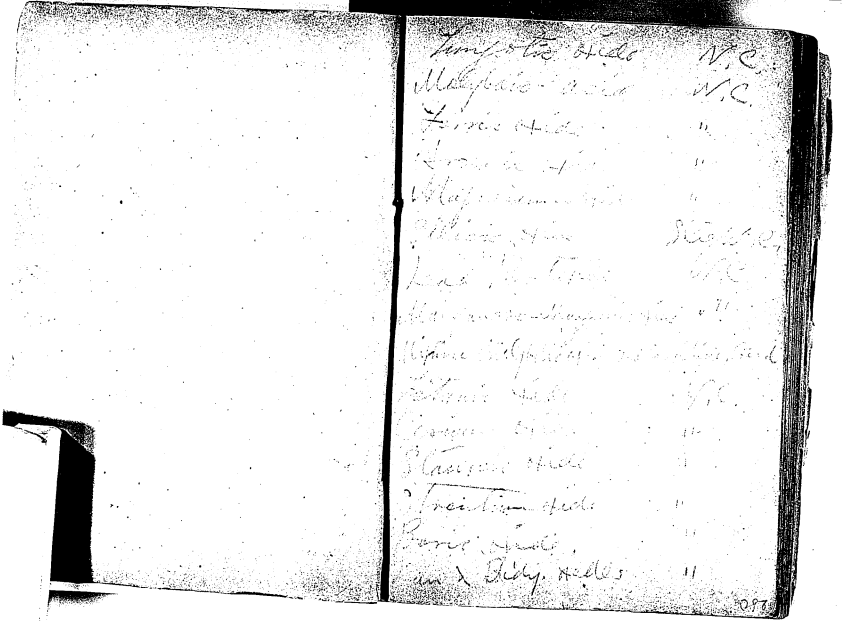
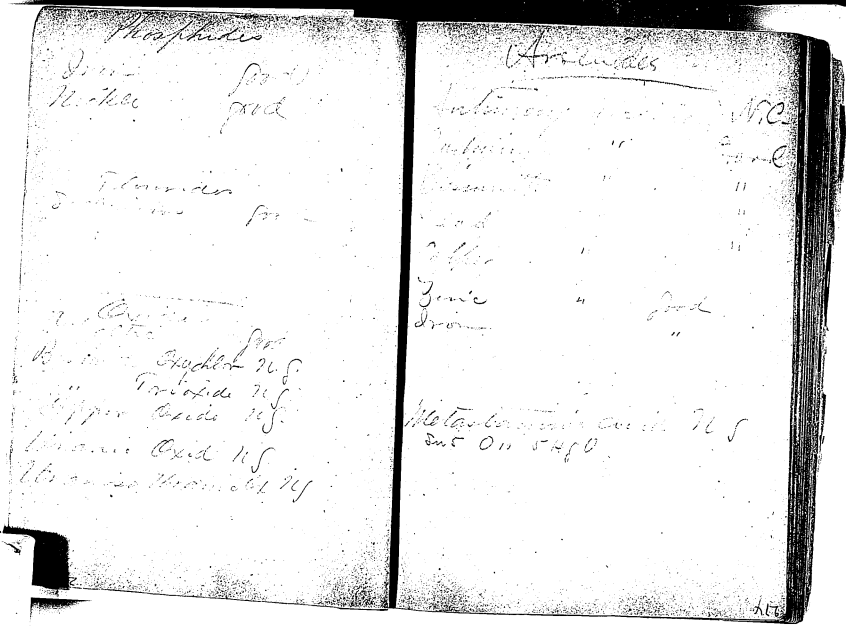


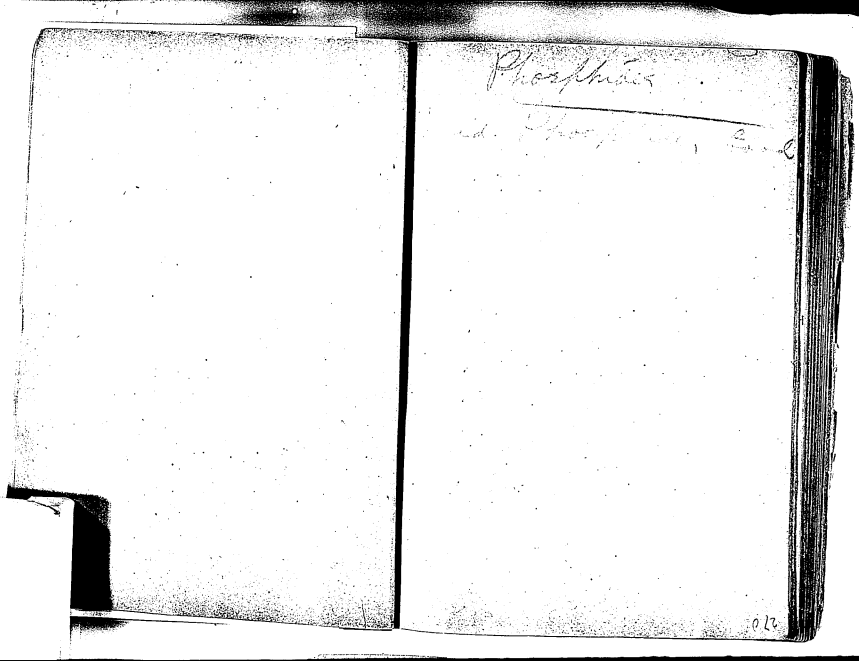
Nickel Peroxide W.C.

Ferro-ferric (Nickel) Good.

115) 6200
31
345
340) 3565
89.

2,00) 62,00
31




Phosphates
022

~~Solubility~~

Solubility of

Hydrogen-dioxide Phosphate

50 c.c. distilled H_2O at 25° C = 49.5 Gr.

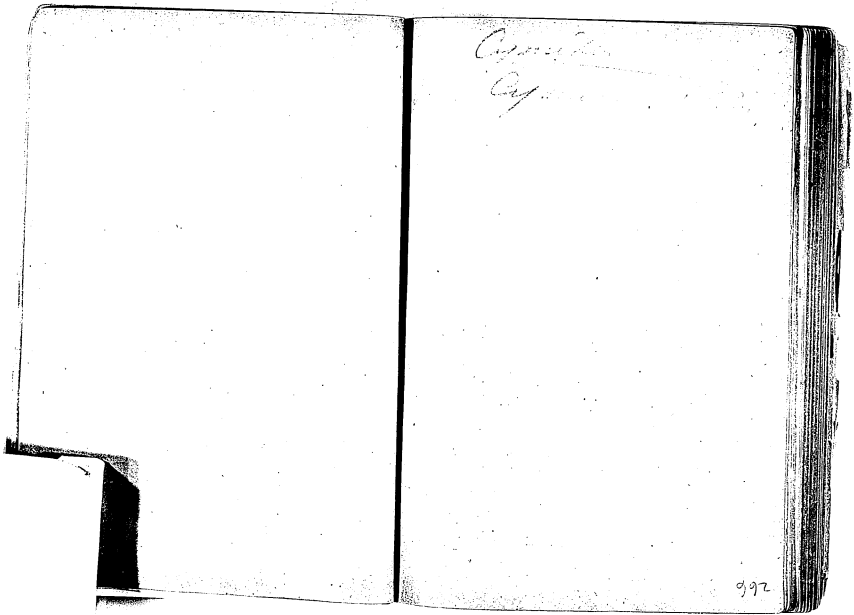
50 c.c. H_2O + 5 Grams [illegible] = 54.8 Gr.

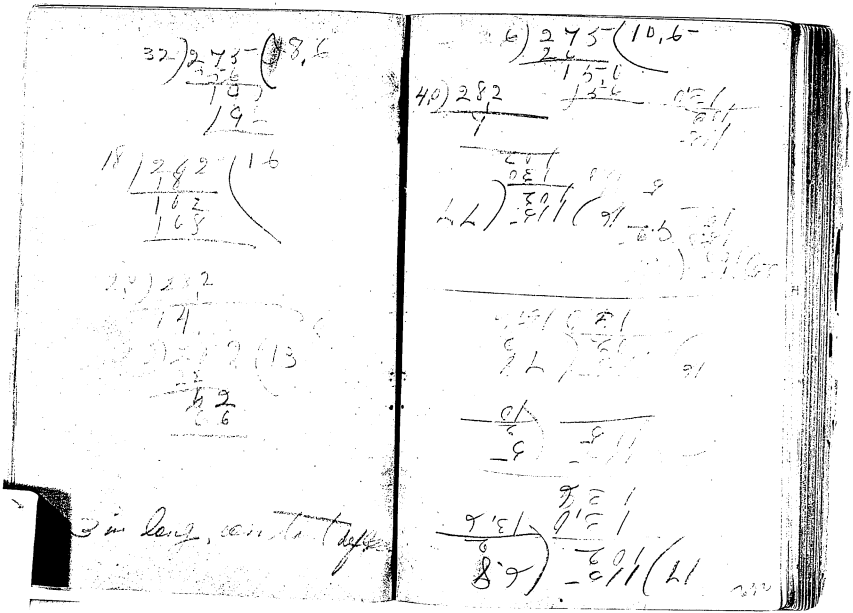
50 c.c. H_2O + 5 " = 53.00 Gr.

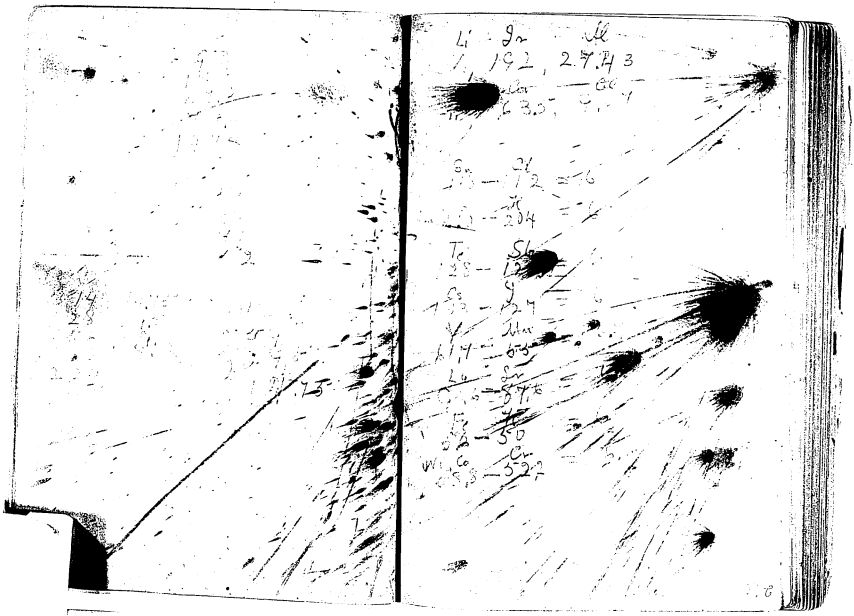
50 c.c. at 5% Na sodu = 52.6 Gr.

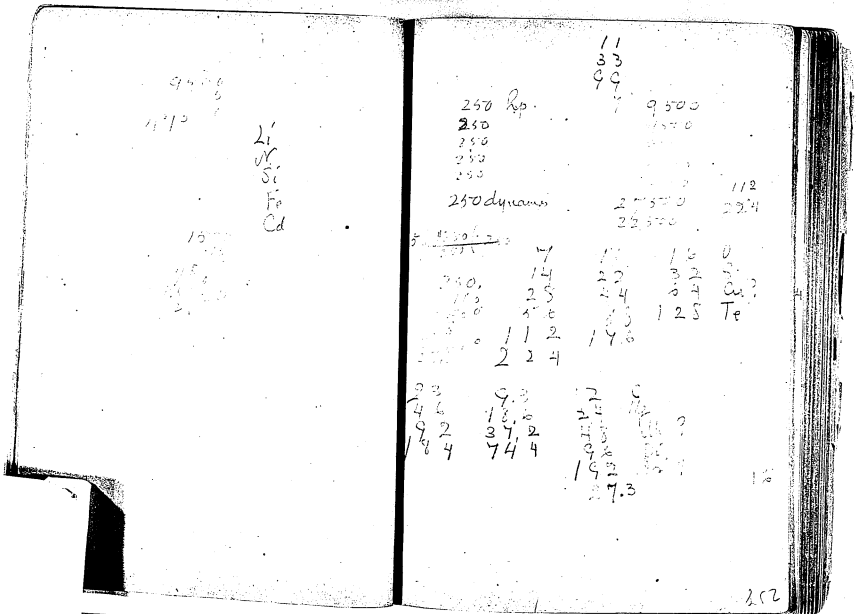
" = 3.

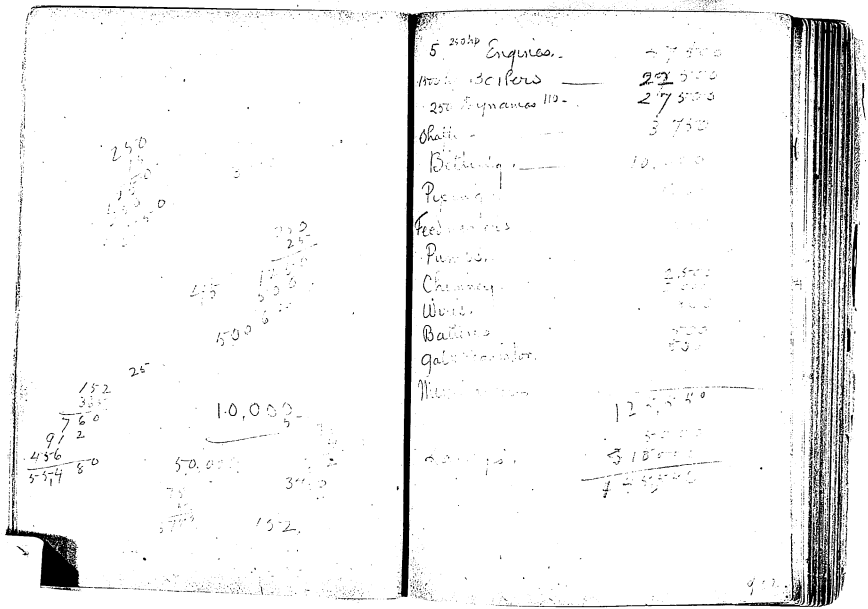
20 parts by weight [illegible] in 100 parts H_2O at 25° C.

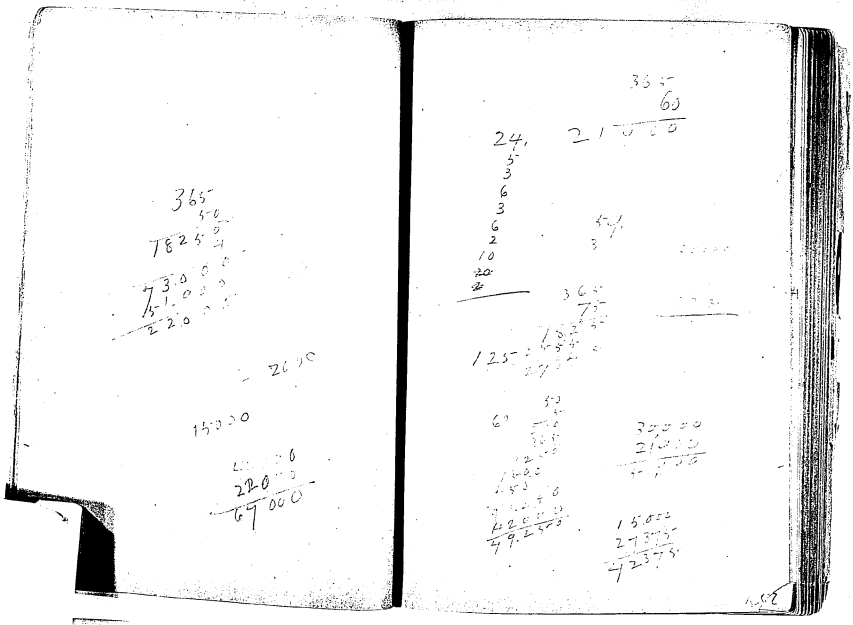


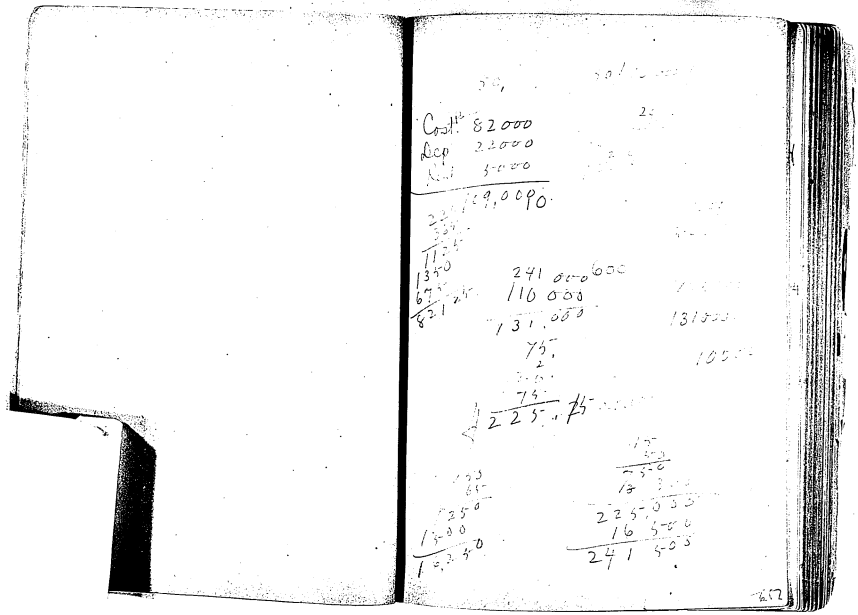





250 dynes
Li
K
Si
Fe
Cd
Te






Cash 82000
Dep 22000
5000
109000
241 000 600
110 000
131 000 000
75
225 75
225 0 0 0
16 5 0 0
241 5 0 0

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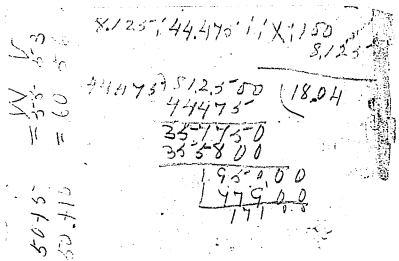


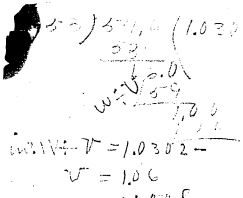
All through before
Sulphur charge

Sulphur 20
Tin 20
Chl Am 20
after first heating
stirred up + added
more chl. by 5% &
Reps down heat
but seems to blacken
Now

Sulphur 40
Tin 40
Chl Am 40
good but blackens a
little on b/p Heat 40

Sulphur 40
Tin 40
Chl Am 40
not good

Tin 40
Sulph 15
Chl Am 15
about work good
seems to blacken



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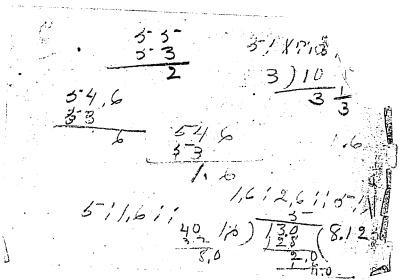

Daniel: CCC through 6200 Ohms
= 280°

Those are more through to 3100
Ohms = 40°

40) 280° (7 ; 7×2=14
280

R = .13

Those between 3100 Ohms = 37°

R = .04 37) 280 (7.4 ; 7.4×2=14.8
259
210

15,4
10,2
5,2

(Lowe and Child & Auttmann) Those between 2.8 Ohms
= 5.5° R less than .01

2,00) 62,00 55) 280 (5
51 275
5
55

5
55

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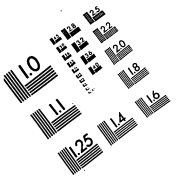
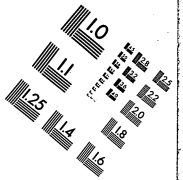
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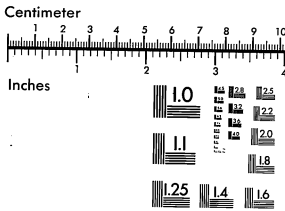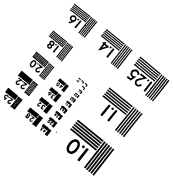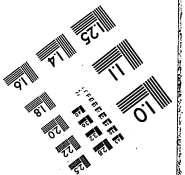
Centimeter
Inches
mm